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No. 20

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TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 20

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AGROTECHNOLOGY

COMPARISON OF BULGARIAN AND AMERICAN VITAMIN SUPPLEMENTS DESCRIBED

Moscow MEZHDUNARODNYY SEL'SKOKHOZYAYSTVENNYY ZHURNAL in Russian No 4, 1977
pp 107-108

[Report by F. Kanev and N. Lalov, senior scientific workers, and L. Georgiyeva, Institute of Grain and Mixed Feed Industry, Sofia: "Comparative Testing of Bulgarian and American Vitamin Supplements and Mixed Feed Recipes for Hogs"]

[Text] The drastic increase in productivity and improved health of hogs achieved in the past 10 to 15 years has in great part resulted from the use of various biologically active substances and medicines in mixed feed. Their quantities are constantly increasing. The majority of these feed additives are only effective when used in precisely defined quantities evenly distributed in mixed feed for the different categories of hogs. In order to achieve this uniformity the microingredients are first prepared in supplement mixtures before being added to the mixed feed. Due to the great importance of supplements with respect to increasing hog productivity and improving utilization of the nutritive substances in the rations and keeping the animals healthy research work involved in their testing has been stepped up in recent years both in our nation[1] and abroad [2,3,4,5,6].

In 1975 we imported supplements for hog rations produced by the U.S. company of Central Soya. They were tested in the feed mixtures represented by the producer, together with domestically produced supplements and feed mixtures. We conducted these comparative tests in 1975 at a hog raising complex in the village of Manola, Plovdiv Okrug.

The American pre-starter and starter mixes include oxytetracycline, sulfadimezin and penicillin, and in supplements used during the fattening period (when the animals weigh between 60 and 100 kg.), tylasin as well.

We conducted three applied-scientific tests. For the first test we formed two groups of 32 piglets each, uniform with respect to breed (White Bulgarian x Landrace), sex (16 males and 16 females), age, and live weight. The animals were raised from a weight of 4 kg. to 20 kg., live weight. In this study we

Table 1. Composition of Feed Mixes (in percentages)

(1) Компоненты	(2) Контрольные смеси				(3) Опытные смеси			
	(4) пред-стартер	(5) стартер	(6) 20—60 кг	(6) 60—100 кг	(4) пред-стартер	(5) стартер	(6) 20—60 кг	(6) 60—100 кг
Кукурузная дерть (7)	35,37	38,60	40,00	54,80	53,20	63,10	77,00	73,60
Ячменная дерть (8)	—	—	34,55	24,00	—	10,00	—	—
Пшеничная дерть (9)	30,00	31,00	—	—	—	—	—	—
Пшеничные отруби (10)	—	—	7,0	6,0	—	—	—	7,30
Соевый шрот (11)	18,50	20,50	12,50	7,0	22,00	13,10	9,20	7,80
Подсолнечниковый шрот (12)	—	—	—	—	—	—	4,10	4,00
Рыбная мука (13)	4,00	4,00	—	—	2,50	4,00	5,00	2,60
Кормовые дрожжи (14)	—	—	—	—	5,00	5,00	—	—
Мясо-костная мука (15)	—	4,00	—	3,00	—	—	—	—
Люцерновая мука (16)	—	—	3,00	3,00	—	—	0,50	0,50
Сухое обезжиренное молоко импортное (17)	10,00	—	—	—	5,00	—	—	—
Мел (18)	0,70	0,60	1,10	0,90	—	—	0,60	0,70
Смесь микроэлементов (19)	0,10	0,10	0,10	0,10	—	—	—	—
Поваренная соль (20)	0,20	0,20	0,30	0,40	0,20	0,50	0,50	0,50
Лизин (21)	—	—	0,05	—	—	—	—	—
Премикс (22)	0,50	0,50	0,50	0,50	10,00	2,50	2,50	2,50
Лекарственный премикс (23)	—	—	—	—	0,20	0,20	0,20	0,10
Дикальциевый фосфат (24)	0,60	0,50	0,90	0,30	1,90	1,60	0,40	0,40
Сладкий сдабривающий корм (25)	0,03	—	—	—	—	—	—	—
В 1 кг кормовой смеси содержатся: (26)			1,150	1,174	1,088	1,184	1,198	1,166
кормовых единиц (27)	1,200	1,190						
сырого протеина, г (28)	205,6	205,4	141,4	131,6	196,6	169,00	154,0	140,2
сырой клетчатки, г (29)	27,4	30,6	54,8	47,8	28,8	32,6	32,4	37,8
лизина, г (30)	11,84	11,02	7,10	6,66	11,96	9,50	7,80	6,48
метионин + цистина, г (31)	7,44	7,00	5,06	4,66	6,96	6,24	6,30	5,60
триптофана, г (32)	2,50	2,36	1,78	1,50	2,34	1,92	1,70	1,58
кальция, г (33)	8,38	8,22	7,68	6,46	7,84	7,00	5,96	5,48
фосфора, г (34)	6,48	6,42	5,44	4,74	8,22	7,88	5,62	5,46
Цена 1 т смеси, в левах (35)	191,90	158,40	113,10	117,50	294,40	185,80	154,30	144,80

Key:

1. Ingredients
2. Control mixes
3. Test mixes
4. Pre-starter
5. Starter
6. Kg.
7. Chopped corn
8. Chopped barley
9. Chopped wheat
10. Wheat bran
11. Soybean meal
12. Sunflower seed meal
13. Fish meal
14. Nutrient yeasts
15. Meat-and-bone meal
16. Alfalfa meal
17. Imported dry, skim milk
18. Chalk
19. Mixture of trace elements
20. Sodium chloride
21. Lysine
22. Supplement
23. Drugs
24. Decalcified phosphate
25. Seasoned sweet feed
26. One kg. of feed mix contains:
27. Feed units
28. Crude protein, gms.
29. Crude cellulose, gms.
30. Lysine, gms.
31. Methionine + cystine, gms.
32. Tryptophan, gms.
33. Calcium, gms.
34. Phosphorous, gms.
35. Price of 1 ton of mix, in levs

tested Bulgarian and imported supplements and mixed feed recipes for the prestarter and starter periods.

The second test also involved two groups of 32 piglets each, of identical breed, sex, age and live weight, which were fattened from a live weight of 20 kg.to 100 kg. This study was also continued with the same piglets involved in the first test. We decided to continue and complete the cycle of raising piglets intended for fattening from the age of 8 days, that is, from the time the pre-starter mix began to be fed until they reached slaughtering size.

In this study also we tested American and Bulgarian supplements and mixed feed recipes for the fattening period between 20 and 60 kg. and between 60 and 100 kg. of live weight.

The third test, like the second, involved two groups of 60 piglets each (30 males and 30 females, White Bulgarian x Landrace), identical in the above indices and fattened from a live weight of 20 kg. to 100 kg.

The pigs were kept in groups of 15, each group in a single stall. The feed mixes were prepared in the form of meal and were fed in accordance with the general technology employed: in dry form up to a live weight of 60 kg. and moistened between the weights of 60 and 100 kg.

At the end of the fattening tests a slaughter and chemical analysis of the meat (Musculus long. dorsi) was conducted.

The feed mixes used for the pigs are given in Table 1.

The tabulated results of the three tests are given in Table 2. These data indicate the following.

In the first test the average daily weight gain for pigs in the test group was 18.93% greater and feed utilization 11.68 better than for animals in the control group.

In the second test pigs in the test group had a 9.58% greater average daily weight gain and 3.48% better feed assimilation and had a higher dressing-out percentage (by 5.5%), a greater average lard thickness (by 0.14 cm.), less carcass meat excluding skin (by 0.39%) and a higher protein content in the meat (by 1.46%). A total of 103.28 levs more was spent per ton of weight gain in live weight for the tested pigs fed with supplements and American feed mixes than for the control animals fed supplements and feed mixes.

In the third test pigs in the test group had a 1.84% higher average daily weight gain, 1.12% better feed assimilation, a higher killing-out percentage (by 4.09%), increased lard thickness (0.20 cm), less carcass meat excluding skin (3.29%) and a higher protein content (0.18%). In this test as well the cost of the feed mixes expended per ton of weight gain in live weight was 102.14 levs greater than for the test pigs.

Table 2. Weight Gain, Feed Assimilation and Meat Analysis

(1) Показатели	I опыт. Вес поросят от 4 (2) до 20 кг		II опыт. Вес поросят от 20 (3) до 100 кг		III опыт. Вес поросят от 20 (4) до 100 кг	
	контрольная группа 5)	опытная группа 6)	контрольная группа 5)	опытная группа 6)	контрольная группа 5)	опытная группа 6)
Число животных в группе 7)	32	32	32	32	60	60
Средний вес животного в начале опыта, кг 8)	4,66	3,96	16,34	22,16	23,00	23,07
То же, в конце опыта, кг 9)	16,34	22,16	99,81	94,90	107,50	110,17
Среднесуточный привес, г 10)	243	289	553	606	593	604
Расход кормовых смесей на 1 кг привеса 11)	1,37	1,21	3,73	3,60	3,89	3,73
Убойный выход (без учета шкуры), % 12)	—	—	65,17	70,67	67,22	71,31
Средняя толщина спинного шпика, см 13)	—	—	3,00	3,14	3,80	4,00
Соотношение мяса и сала в туше, %: 14)		—				
мясо 15)	—	—	67,33	66,94	68,94	65,65
сало 16)	—	—	32,67	33,06	31,05	34,35
Содержание мяса в окороке, % 17)	—	—	74,87	72,42	69,80	65,10
Содержание сала в окороке, % 18)	—	—	25,13	27,58	30,20	34,90
Большая длина туши, см 19)	—	—	96,00	93,50	93,00	92,50
Содержание в мясе, %: 20)						
воды 21)	—	—	74,31	73,20	72,03	70,38
протеина 22)	—	—	22,97	24,43	21,67	21,85
жира 23)	—	—	5,07	4,70	4,83	5,28
золы 24)	—	—	1,10	1,10	1,14	1,03
Стоимость кормовых смесей на 1 т привеса, в левах 25)	—	—	432,66	535,93	449,90	552,04

Key:

1. Indices
2. First test. Pig weight from 4 kg. to 20 kg.
3. Second test. Pig weight from 20 kg. to 100 kg.
4. Third test. Pig weight from 20 kg. to 100 kg.
5. Control group
6. Test group
7. Number of animals in group
8. Average animal weight at beginning of test, kg.
9. The same, at end of test, kg.
10. Avg. daily weight gain, gms.
11. Consumption of feed mixes/kg. wt. gain
12. Killing-out % (excluding skin)
13. Avg. thickness of back lard, cm.
14. Ratio of meat and lard in carcass, %
15. Meat
16. Lard
17. Meat content of ham, %
18. Lard content of ham, %
19. Maximum carcass length, cm.
20. Meat contained, %:
21. Water
22. Protein
23. Fat
24. Ash
25. Cost of feed mixes per ton of weight gain, in levs

Conclusion: The test pigs fed the American supplements and feed mixes recommended by Central Soya achieved comparatively good zootechnical results. Our supplements and feed mixes also produced good results under the same production conditions. The third test showed a minimal improvement of indices in the animals. The control group of animals had a higher percentage for two indicators: average lard thickness and meat content of carcass not including skin. Furthermore, one ton of Bulgarian feed mix cost 102-103 levs less than one ton of the feed mixes recommended by Central Soya. The price of imported supplements is a great deal higher than that of domestic supplements. The use of Bulgarian feed mixes and supplements is therefore more economical.

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CEMA NATIONS COOPERATE IN PRODUCTION OF FEED ADDITIVES

Moscow MEZHDUNARODNYY SEL'SKOKHOZYAYSTVENNYY ZHURNAL in Russian No 4, 1977 pp 27-30

[Article by M. Garbar, deputy chief of the Chemical Industry Section of the CEMA Secretariat, and B. Geyze, section expert: "Joint Measures in the Area of Industrial Production of Feed Protein and Other Biologically Active Substances"]

[Text] The communist and workers' parties of the socialist nations demonstrate constant concern for improving the welfare of their nations' workers. A great deal of attention is devoted to continuously increasing production of food products for more complete satisfaction of the population's need for high-quality food products.

The planned implementation of appropriate measures to further the conversion of animal husbandry to an industrial basis and to increase the production of meat, eggs, milk and other animal husbandry products is continuing in the socialist commonwealth of nations during the current five-year period.

Organizing animal husbandry on an industrial basis requires the continuous output of products throughout the entire year, which requires a smooth and uninterrupted supply of livestock feed of a certain composition, both in summer and in winter. This can only be achieved by converting feed production to a modern industrial basis.

The use of chemical and biochemical feed additives is one of the most important factors characterizing the intensive development of modern animal husbandry. It has been scientifically proven that the main condition for the successful development of animal husbandry industrially is a supply of fully nutritional feed containing not only an adequate amount of protein but also the essential amino acids, vitamins and other biologically active substances.

Research conducted in the CEMA nations, however, has shown than in most cases natural feed does not contain the amount of protein and essential amino acids -- lysine, methionine, tryptophan, and others -- essential for the development of a highly productive animal husbandry.

Various vitamins must also be added to the rations, since research and experience have shown that they are contained in feed in small quantity, frequently inadequate for livestock. In addition, a considerable portion of them is lost during the preparation and storage of the feed and part of them are in unavailable form. Vitamin deficiencies in livestock feed, balanced with respect to other nutrients, reduces the animals' productiveness: it slows their growth and development, reduces their fertility, leads to overconsumption of feed and increases the basic cost of products.

Because of deficiencies of protein, amino acids, vitamins and other biologically active substances in livestock rations the productiveness of livestock and poultry increases slowly, utilization of the breeding stock deteriorates, the young animals grow poorly and their health is weakened, and the basic cost of products and labor expenditures increase.

It is therefore important to produce feed concentrates which include the essential quantity, variety and form of various biologically active substances -- nutrient yeasts, amino acids, vitamins, antibiotics and others.

Nutrient yeasts are added to feed in order to increase its nutritional value. They contain 45-60 percent raw protein and a large quantity of lysine, as well as methionine, cystine, tryptophan and B and D vitamin complexes.

Many years of experience has demonstrated the great biological value of this type of industrial feed additives. Nutrient yeasts increase the biological value of rations, even those containing such high-protein feed as meat-and-bone meal, peas and sunflower meal. Rations with yeasts added help to increase the growing vigor of hogs and poultry, to protect them against a number of diseases, increase their fertility and the survival rate of newborn offspring, and make it possible to utilize the protein in plant feed more completely. Weight gains for hogs are increased almost 50 percent by adding nutrient yeasts to the rations, for example. The use of 1 ton of nutrient yeast in livestock rations makes it possible to save more than 3 tons of feed grain as a result of better utilization of the basic feed.

In the CEMA nations nutrient yeasts are produced from various types of raw materials. The development and industrial mastery of the process of obtaining nutrient yeasts from petroleum paraffins was first accomplished in the USSR.

The slow technical and economic effect is considerably increased when lacking vitamins and amino acids, as well as antibiotics and enzymes are added to the rations along with nutrient yeasts. At the present time a great deal of experience has been accumulated in the use of amino acids in the rations of livestock and poultry.

It is mainly lysine and methionine which are lacking in hog and poultry feed. The addition of lysine to hog and chicken rations makes it possible to reduce the consumption of protein by 20-25 percent, to reduce feed consumption by 10 percent, and simultaneously to raise animal productiveness by 10-11 percent.

The enrichment of feed with methionine increases productiveness of young chickens and layers. Meeting the needs of animal husbandry for nutrient protein, amino acids, vitamins and other biological substances is therefore one of the urgent national economic problems of the CEMA nations.

In the CEMA nations the above-mentioned additives are produced by microbiological and chemical synthesis and form an important additional source of nutrient protein for feeds of plant and animal origin and efficient, biologically active substances.

The microbiology industry is one of those new batches of industry resulting from the contemporary scientific and technical revolution and designed to insure technical progress in the national economy and to make public production considerably more efficient. The technological processes involved in microbiological synthesis are based on the use of microorganisms: yeast, mold and ray fungi and various bacteria.

The microbiological method makes it possible to obtain essential quantities of products, the chemical synthesis of which is still impossible or extremely difficult and expensive. Non-food materials (inferior lumber, the byproducts of various production processes, petroleum hydrocarbons, and others) serve as the main raw material for these microbiological processes. Another advantage of the industrial production of nutrient yeast and other biologically active substances is the fact that plants produce these products regularly, both in summer and winter: their operations do not depend on weather conditions and the use of hydrocarbon raw materials makes it possible to create large capacities with optimal technical and economic indices.

This is why in the CEMA nations a great deal of attention is being devoted to the production of nutrient protein, as well as chemical and biochemical feed additives and to the development of cooperation in this field.

The comprehensive program for further intensification and improvement of cooperation and for the development of socialist economic integration among the CEMA nations, adopted at the 25th Meeting of the CEMA Session, calls for the development of proposals for the extensive realization of specialization and cooperation in the production of amino acids, vitamins and other feed additives for animal husbandry, taking into account the construction of proper production capacities through the joint effort of the nations concerned, as well as the development of proposals on cooperation among the interested CEMA nations in organizing the production of nutrient yeasts using petroleum raw materials.

Based on the corresponding decisions of the Executive Committee of the Council for Mutual Economic Assistance, the Standing CEMA Commission on the Chemical Industry has adopted at its meetings coordinated decisions on the fulfillment of assignments specified by the Comprehensive Program.

Specifically, the 42d meeting of the Commission approved the "Long-Range Program for Cooperation Among the CEMA Nations and Yugoslavia in Developing the Production of Mineral Fertilizers, Nutrient Yeasts, Chemical, Biochemical and Mineral Feed Additives," developed at the assignment of the 56th meeting of the Council's Executive Committee, with the participation of qualified representatives of those nations in the field of agriculture. The program contains measures aimed at fulfilling assignments specified in the Comprehensive Program.

The above program calls for the development of cooperation among nations in the commonwealth in the coordination of national economic plans for the production of nutrient yeasts, amino acids, vitamins and other feed additives, scientific and technical cooperation, product standardization, environmental protection, and so forth.

The measures outlined in the Long-Range Program are being carried out on a planned basis. The 45th meeting of the CEMA Standing Commission on the Chemical Industry approved materials on the multilateral coordination of plans for developing the production of feed additives for the period 1976-1980 and for the long range, up to 1990, recommended that the CEMA nations use in their work the materials contained therein, and outlined plans for the development of a number of proposals on cooperation.

A decision was adopted on cooperation in the production of the following chemical and biochemical feed additives:
- – nutrient yeasts;
- – amino acids – lysine, methionine, tryptophan, sodium glutomate;
- – vitamins A, B_2, B_3, B_4, B_{12}, BC, D_3, E, K_3, PP;
- – enzymes – – amylosubtilin GZkh, protosubtilin GZkh, pectavamorin P10kh;
- – antibiotics – – bacitracin, kormogrizein, hygromycin, flavomycin, virginiamycin, tylosin;
- – growth stimulants – – dimetridazol, karbadox, nitrovin;
- – antioxidants – "etoxykhin", butyhydrooxitoluol;
- – preservatives – – propiolic acid, formic acid, sodium benzoate.

Materials on multilateral plan coordination defined the need to develop the rpoduction of individual feed additives, the expediency of specializing their production, and the development of scientific and technical cooperation in this field.

The CEMA nations and Yugoslavia have outlined plans for the period 1976-1980 and for the long-range, up to 1990, for the production of feed additives to satisfy their own requirements. The plans also take into account the need to provide interested socialist nations with these additives in accordance with the plans for production specialization and cooperation. The nations' needs for a number of products are not being fully satisfied as yet, however.

Considering the great importance of the nutrient protein problem, at its 28th meeting the Council Session assigned the Executive Committee the task of developing proposals on cooperation among the CEMA nations for purposes of satisfying the needs of animal husbandry for nutrient protein from plant, animal and microbiological sources.

In accordance with an assignment from the 68th meeting of the Council's Executive Committee on this matter the 46th meeting of the CEMA Standing Commission on the Chemical Industry approved a report on the status of and ways to increase the production of feed additives and a proposal on cooperation among the CEMA nations and Yugoslovia for meeting the needs of animal husbandry for nutrient protein of microbiological origin, which were forwarded to the CEMA Standing Commission on Agriculture and reviewed in a temporary comprehensive working group on the problem of nutrient protein.

At its 74th meeting the Council's Executive Committee approved these proposals and a plan covering basic measures for their realization, which calls for extensive development of cooperation among the nations in the area of increasing the production of feed additives, and assigned the CEMA Standing Commission on the Chemical Industry the task of taking necessary steps toward the specification, development and timely fulfillment of the assigned tasks.

At its 48th meeting the CEMA Standing Commission on the Chemical Industry established the procedure for fulfilling these assignments from the Executive Committee and outlined plans for the development of a number of proposals on their fulfillment (the creation and expansion of capacities for the production of feed additives, the development of cooperation in the creation of highly productive equipment and means of automation for the microbiology industry, further specialization in the production of feed additives, and others).

Proposals are being developed on cooperation in the production of a number of chemical and biological feed additives: nutrient yeasts, lysine, methionine and other amino acids; vitamins A, D_3, E and others; enzymes, antibiotics, growth stimulants, antioxidants, and preservatives.

In order to satisfy the growing needs for nutrient yeasts, all of the commonwealth nations have planned to develop production, utilizing their existing raw materials base. A number of nations will totally satisfy their requirements for nutrient yeasts by 1980-1985 through their own production and in part, by importing them from the socialist nations.

A decision adopted at the 29th meeting of the Council Session on a coordinated plan of multilateral integrated measures calls for construction in the USSR, through the joint efforts of Bulgaria, Hungary, the GDR, Poland, Romania, the USSR and Czechoslovakia of a plant in Mozyr' capable of producing 300,000 tons of nutrient yeasts annually from highly refined paraffins. Realization of this cooperation will increase satisfaction of the needs of CEMA nations now importing nutrient yeasts by 15-25 percent.

For purposes of further developing cooperation among the CEMA nations with respect to meeting their needs for nutrient protein of microbiological origin proposals are also being worked out for expanding existing capacities and creating additional capacities for the production of nutrient yeasts of various types of raw materials. This is being done in accordance with assignments made at the 74th meeting of the Council's Executive Committee. Scientific and technical cooperation in the microbiological synthesis of nutrient yeasts will be expanded (the selection of highly productive strains, plus the development of proved technologies for obtaining nutrient biomass from carbohydrates and hydrocarbons, the creation of highly productive technological equipment, and others).

In addition, it is planned to develop during the period 1976-1980 the production of lysine by microbiological synthesis from various types of raw materials. Proposals are being worked out on the creation in Czechoslovakia of a scientific research laboratory on the problem of lysine technology for purposes of combining the efforts of interested CEMA nations for conducting studies and planning and design work to improve the technology for obtaining this amino acid and the technological equipment.

In order to meet the nation's needs for methionine a proposal is being worked out for creating in Poland through the joint efforts of the interested CEMA nations a plant for the production of this amino acid.

In order to increase the production of vitamins A and E proposals are being developed for the creation in the USSR and Czechoslovakia through the joint efforts of the interested nations of capacities for the production of these products, based on existing technology and the use of modern scientific and technical achievements.

Decisions adopted at the 29th and 30th meetings of the CEMA Session call for the development and realization of a long-range, focused program of measures for cooperation among the CEMA nations for the period up to 1990 on the problem of raw materials, fuel and energy, specifically, in the area of production of the most important feed additives.

The CEMA Standing Commission on the Chemical Industry has also performed work aimed at specializing the production of feed additives. In March 1976 the CEMA nations and Yugoslavia signed the Agreement on Multilateral International Specialization and Cooperation in the Production of Seven Types of Chemical and Biochemical Feed Additives. This Agreement calls for providing the interested nations with vitamins B_3, B_4, B_6, E, K_3 and PP and with bacitracin to satisfy their needs for these products.

Proposals are also being developed to increase the production of feed additives for delivery to the interested CEMA nations on a multilateral and bilateral basis (vitamins B, B_4, D_3 and others). The long-range needs for technological equipment for the microbiological industry, its parameters and technical specifications have been defined.

For purposing of expanding scientific and technical cooperation a plan has been developed for conducting scientific studies during the period 1976-1980 on the problem of microbiological and chemical synthesis of feed additives. A scientific and technical council has been created for coordinating this work. It began functioning in 1975.

The plan calls for scientific and technical cooperation among the CEMA nations and Yugoslavia in the technology of producing nutrient protein from non-food raw materials, the production of enzyme preparations, essential amino acids by microbiological synthesis, vitamins by microbiological and chemical synthesis, non-medical antibiotic admixtures, and environmental protection. Bulgaria, Hungary, the GDR, the Republic of Cuba, Poland, Romania, the USSR, Czechoslovakia and Yugoslavia have stated their interest in this cooperation.

Mutually beneficial cooperation among the CEMA nations and Yugoslavia in the production of chemical and biochemical feed additives is successfully developing. This will contribute to more intensive development of animal husbandry in the nations, as a result of which the workers' welfare will improve.

11499
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HEALTH EDUCATION OF THE POPULATION IN THE USSR

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 18-19

[Article by D.N. Loranskiy, candidate of medical sciences, Central Scientific Research Institute of Health Education of the USSR Ministry of Health, Moscow]

[Text] The Soviet people are greeting the 60th anniversary of the Great October Revolution by successfully solving the important problems posed by the Communist Party of an upsurge in the cultural level of the population and the education of the new man with the harmonious development of spiritual and physical forces. This is possible only on condition of a further expansion and fundamental improvement in the educational and propaganda work in the light of the decisions of the 25th CPSU Congress. In forming the materialistic understanding of natural phenomena, overcoming survivals from the past, customs and superstitions harmful to health, in raising a physically healthy generation of Soviet people and reducing the frequency of and eliminating many diseases, a considerable role is played by the health education of the country's inhabitants, which is an integral part of the over-all system of health education under the conditions of a socialist society. Soviet health education has a glorious history and tradition. Our comrade in arms, V.I. Lenin, and the first organizer of Soviet public health, N.A. Semashko, could not conceive of a preventive trend in Soviet public health without health education.

In the early years of Soviet power, during the period of the civil war, the health education workers played an important role in the struggle against epidemics and the high infant mortality. N.A. Semashko, speaking in 1919 at the 8th All-Russian Congress of Soviets, emphasized: "Without exaggeration it may be said that if we have stamped out typhus this year, we are to a considerable extent obliged to the vital participation of the people themsleves in this struggle and to widescale health education."

Health education of the population was also the subject of attention of the Communist Party and the Soviet State, and was and is being regarded as an important area of ideological and educational work.

An extremely important landmark in the development of this principle was the adoption by the session of the USSR Supreme Soviet of 19 December 1969 of the "Fundamental Legislation of the USSR and the Union Republics on Public Health," which clearly defined the place and problems of health education in protecting the health of the USSR population. Article 5, "Fundamental Legislation on Public Health," specifies the implementation of health education for the citizens in the system of socio-economic and medical-sanitation measures directed toward protecting the health of the USSR population.

As an independent sector of Soviet public health, health education has a developed network of specialized medical institutions of a new type--houses of health education, of which there are over 500. The various categories of houses of health education engage in active work in hygienic education for the population on the scale of the country's republics, krays and oblasts, cities and rayons. They have become true guiding organizational and methodological and coordinating centers of health education locally, and implement on a wide scale methodological direction and organization, on the territory served, of health education among the population by means of local medical institutions, as well as other, nonmedical, organizations. The houses of health education are staffed with specialists who have a command of the methodology of propagandizing medical and hygiene knowledge among various groups of the population. The houses of health education have archives of methodological literature, illustrated textbooks, projection equipment, etc., and their material-technical base is constantly improving, which reflects the general progress in Soviet public health. An example is the recently published order of the USSR Ministry of Health on providing the houses of health education with motor vehicle transport.

It is important to emphasize the fact that since the early years of the development of Soviet public health, there has been constant implementation of the principle in accordance with which all medical workers, and not only the specialists of the health education houses, take an active part in the population's hygiene instruction. An important role in the practical execution of this principle was played by the order of the USSR Ministry of Health, issued in 1964, which regulated "Requiring from the directors of the public health institutions that they provide for at least four hours a month for mass propaganda of medical and hygienic knowledge among the population in accordance with the specialty of each physician and secondary medical worker, to be counted toward their work time."

The "Fundamental Legislation on Public Health (article 31) reinforced the principle of a comprehensive approach to problems of health education for the population of the USSR, in accordance with which the "organs and institutions of public health, in conjunction with the organs and institutions of science, culture and public education, with the active participation of the Red Cross and Red Crescent societies and other public organizations, are called upon to ensure the propaganda of scientific medical and hygiene knowledge among the population." The demand for comprehensive participation of various ministries, departments and public organizations to preach hygiene

education was caused by the scale of this sphere of educational work and the need to encompass different age, vocational and other groups of the population. Comrade L.I. Brezhnev, general secretary of the CPSU Central Committee, in the report to the 25th Party Congress, advanced and thoroughly substantiated the idea of a comprehensive approach to formulating the entire cause of educating the population of the country in consideration of the characteristics of various groups of workers.

Soviet public health has considerable experience in the comprehensive approach to problems of hygiene instruction and education of the country's population, which found practical expression in the "Comprehensive Plans for Basic Measures for Hygiene Instruction and Education of the Population," worked out and carried out on all-union, republic, oblast (kray) and municipal levels of administration, as well as according to the sectorial principle. The group of participants in fulfilling these plans is constantly expanding. For example, in the comprehensive "Plan for Basic Measures for Hygiene Instruction and Education of the Population of the USSR in 1976-1980," measures are specified for over 100 ministries, departments and public organizations in the country. The new "Comprehensive Plan" reflects the principal directions in the development of the USSR national economy in 1976-1980 and the broad program outlined by the 25th CPSU Congress for the development of production relations and the formation of the new man. An important role in executing the comprehensive plans is played by the All-Union Council of Health Education, established in 1956 at the USSR Ministry of Health as an interdepartmental organization to implement public direction of health education in the country. Since 1957 the All-Union Council of Health Education has been a member of the International Union of Health Education.

The scientific-methodological center of health education in the country is the Central Scientific-Research Institute of Health Education of the USSR Ministry of Health, which is preparing to mark its 50th anniversary. The institute carries out a comprehensive approach to solving problems of hygiene education not only in the practical work of health education, but also in scientific research. The decree of the presidium of the USSR Academy of Medical Sciences, adopted in 1976, on confirming the problem of union significance, "Health Education," and the problem commission of the same name, was important. The Central Scientific Research Institute of Health Education was confirmed as the head institution for the problem. Departments and institutes located in various republics (RSFSR, Uzbek, Kazakh, Georgian, Kirgiz and others) and regions in the country are now participating in the planned development of health education.

An exceptionally broad range of questions and problems solved by Soviet health education at the present stage is primarily the propaganda of various aspects of a healthy way of life. The successful fulfillment of the programs of the preceding five-year plans, and the vast outlines for the Tenth Five-Year Plan create favorable opportunities for solving the principal socio-economic problems posed by the Party Program for a further improvement in the labor conditions and everyday conditions for the Soviet people for all-round

development of the personality and the formation of the new man. The socialist way of life specifies the inculcation in the entier population of habits and needs that would permit the most efficient use of achievements in the sphere of housing construction, consumer services, education and culture, for the purpose of reinforcing the health of the population.

Our country is actively engaged in propaganda directed toward the proper use of free time, physical culture and athletic activities, correct nutrition, combating drunkenness, alcoholism and smoking. It has now become obvious that the increased well-being of the population, given failure to observe hygienic norms of behavior, may in some cases result in such unfavorable phenomena as obesity due to excessive use of high-calory products, poor organic conditioning under the conditions of hypodynamia, etc. The increased life tempo contributes to a disturbance of psycho-emotional balance in some people. As is known, the unfavorable phenomena listed constitute a group of factors in the risk of developing cardiovascular diseases. Therefore, propaganda for a healthy way of life is closely connected with tasks of developing in the population a readiness to participate in programs for a dispensary system and mass prophylactic examinations.

Our country has an ordered system of hygienic instruction and education for pregnant women, those who have just given birth, and mothers and fathers, which reflects the decision of the 25th CPSU Congress as to the need for a further improvement in guarding the health of the mother and child. An extremely important division of Soviet health education is connected with hygienic instruction and education of schoolchildren and students. The USSR Ministry of Health and the USSR Ministry of Higher and Secondary Specialized Education are taking an active part in this work. The State Committee on Vocational-Technical Education, in close contact with the komsomol organizations, organs of public health and organs and institutions of culture, are carrying out health training of students at technical and vocational and technical schools. Every year, the industrial ministries, in conjunction with the organs of public health, train 15-20 percent of the workers.

The public health organs, trade unions, union of Red Cross and Red Crescent societies, institutions and organizations of municipal services, Ministry of Internal Affairs and other departments are persistently mobilizing the Soviet people to struggle for cleanliness and sanitation services and amenities for the population centers, and for a solicitous attitude toward nature. Widescale training of a public health aktiv is being carried out at enterprises, construction projects and educational institutions of the Society of the Red Cross and the Red Crescent. In the national public health universities, of which there are over 5000, medical and hygiene information is being acquired by over 900,000 persons. The Znaniye Society is engaging in widescale lecture propaganda among the population. Medical and hygiene knowledge is propagandized with the widescale and active participation of television, radio, films and the mass press (for example, the circulation of the journal, ZDOROV'YE, is about 12 million). Along with this, a large role is played by instruction courses for various vocational groups, maternity schools and other forms of group hygiene instruction for healthy and sick people.

The system of hygiene instruction established in our country clearly demonstrates the advantages of socialism in solving the most important problems of preventive medicine. Based on the strong state foundation, the widescale activity of the masses and the achievements of medicine and social sciences, the system of Soviet public health is efficiently solving the problems of training the country's population in hygiene.

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ENVIRONMENTAL HYGIENE ON THE 60TH ANNIVERSARY OF THE SOVIET STATE

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 21-26

Article by G.I. Sidorenko, academician of the USSR Academy of Medical Sciences, Institute of General and Communal Hygiene imeni A.N. Sysin of the USSR Academy of Medical Sciences, Moscow]

[Text] An extremely important role in implementing the planned state policy in environmental protection is played by hygienic science, the principal tasks of which are the study of the interrelations between various factors of the environment and the organism and the scientific substantiation of the optimal parameters of the environment that ensure normal vital activity for man and the human population. The medical aspect is a key factor in the problem of environmental protection, for preserving the health of the population and creating favorable conditions for everyday life, work and leisure for the Soviet people is the main concern of the Soviet State.

The party's policy on public health was expressed with exhaustive completeness in 1918 in the program of the Russian Communist Party (of Bolsheviks), adopted by the 8th Congress, which indicated that the basis of its activity in the sphere of protecting the health of the people of the Russian Communist Party (of Bolsheviks) is above all the carrying out of widescale health and sanitation measures that have as the goal the prevention and study of diseases, by making population centers healthier (soil, water and air protection) and the establishment of state sanitation legislation.

The laws on nature conservation, adopted by all the union republics in 1957-1968, are exceedingly important. The problems of environmental protection in our country have been further developed in such laws as "Fundamentals of Land Legislation of the USSR and the Union Republics" (1968),"Fundamentals of Water Legislation of the USSR and the Union Republics" (1970) and others. Particularly important was the Decree of the CPSU Central Committee and the USSR Council of Ministers "On Intensifying Nature Conservation and Improving the Use of Natural Resources" (1972), which gave precise definition to the legal bases of environmental protection in the USSR and placed the responsibility for nature conservation and carrying out measures to improve health conditions on the appropriate industrial ministries and departments of the USSR and the union republics.

In the "Fundamental Directions for the Development of the USSR National Economy in 1976-1980," adopted by the 25th CPSU Congress, among the most important scientific studies in natural and technical sciences emphasis is made on the need to develop the bases for efficient use and conservation of the soil, underground resources, vegetable and animal world, air and water basins and combatting occupational diseases. The tremendous attention paid by the CPSU and the Soviet government to problems of environmental protection is confirmed by the new draft of the USSR Constitution, which includes the regulation in accordance with which one of the most important functions of the state is environmental protection in the interests of the health and well-being of all the Soviet people.

The principal components of the state legislation are various regulations, rules and norms worked out by hygienists that are called upon to regulate the efficiency of nature conservation, prophylactic and sanitation measures. For example, the hygienic norms became the leading criteria for planning the state sanitation measures at the country's population centers. Not one state has such extensive and improved health legislation as ours. These figures, for example, indicate the scale of development of the hygiene regulation of the environmental quality: the USSR now has scientifically substantiated hygienic norms for the water content in the reservoirs of over 550 chemicals, about 160 in the air of the atmosphere, over 800 in the air of work areas and over 100 chemical compounds in food products; the maximal permissible concentration of harmful substances in the soil has begun to be worked out; norms have been substantiated for the microclimate of the facilities of housing and public buildings, and of medical institutions in various natural-climatic zones; permissible levels of urban and industrial noise and electromagnetic fields of various radio frequencies have been established.

The great importance of hygienic norms and regulations in the matter of the practical implementation of measures to prevent undesirable changes in the environment and protect the health of the population is caused by the need for constant improvement in their scientific substantiation, for if they are not strict enough, damage may be done to the population's health, and if they are too rigid, the economic expenditures to increase the efficiency of the purification installations being constructed will rise sharply. This is precisely why hygiene as a science ensuring the development of criteria for environmental quality should be guided by thorough fundamental research, the importance of which was emphasized in the report made by L.I. Brezhnev, general secretary of the CPSU Central Committee, to the 25th CPSU Congress.

The fundamental research forming the bases of the hygienic norm-setting for various environmental factors was developed by the eminent Soviet hygienists: A.N. Sysin, V.A. Ryazanov, A.A. Letavet, S.N. Cherkinskiy, etc.

In the past decade, attention was drawn to fundamental theoretical research at the Institute of General and Communal Hygiene imeni A.N. Sysin of the USSR Academy of Medical Sciences, due to which domestic hygiene has considerable achievements in this field.

On the basis of the detailed analysis and generalization of the many experimental data obtained in other hygiene studies as well, an opportunity was developed for extrapolation of the results of the study of the general toxic effect of chemical water pollution from animals to man, which makes it possible to count on the reliability of the hygienic norms (G.N. Krasovskiy and coauthors). This method is based on the established general biological conformance to principle, according to which the logarithms of the indices of the toxicity of substances and the biological parameters of mammals are in a linear correlational relation to the logarithms of the body weight (allometrical correlations). They showed that the average length of life for mammals (excluding man) is related in a linear manner to their body weight. A mathematical analysis of this relationship, as well as the constant established by Rubner, makes it possible to think that the average life span of any animal corresponds (is equivalent) to only 15-17 years in human life, and all the rest of the years of life of people above this value are the result of social factors, the social living conditions of the human animal--social, according to the precise characteristics of K. Marx. The fact revealed of the lack of equivalency in the life span of man and animals is important for working out a general theory of model study of pathological processes in medicine. Apparently, it should also be taken into consideration in the experimental study of the long-term results of the effect of chemical pollutants of the environment (particularly the carcinogenic effect and the aging effect). A great role was played in increasing the reliability of the hygienic norms by the USSR Ministry of Health's approval of the "Methodological Directions for the Development and Scientific Substantiation of the Maximum Permissible Content of Harmful Substances in the Water of Reservoirs" (S.N. Cherkinskiy), which was based on the results of both the above enumerated theoretical and the experimental studies on substantiating the maximum permissible concentration.

The results of many years of research which showed that with continuous inhalation of substances, the relationship of concentration--time for the onset of generally toxic and allergenic and gonadotixic effects is in the nature of a hyperbole that in a grid with a logarithmic scale may be approximated by straight lines with differing angles of incline, is of great theoretical and practical significance. This analytical relationship may be expressed by the equation of the power function $y = ax^6$ The relationship established was tested on substances with different toxindynamic properties. On the basis of this relationship, a system was worked out for the first time in hygienic science of toxicometric parameters of atmospheric pollutants, the methods of determining and predicting and also the classification of chemical compounds according to the degree of their danger, and on its basis--nomograms for the evaluation of the degree of actual pollution of the atmospheric air (G.I. Sidorenko; M.A. Pinigin and coauthors).

Definite progress has now been achieved in establishing the relationship between the chemical structure of various classes of chemical compounds and their toxic properties. Revealing the objectively existing correlations between the physical-chemical constants of substances, the biological

activity and indices of their toxicity and danger made it possible, for example, to establish the correlation between the indices of the average fatal doses and the average fatal concentrations of the same substances. This relation is expressed by the equation $\lg LD_{50}=0.5 \lg Dcl_{50}+2.55$. Such mathematical models are recommended for use to predict dangerous levels of chemical pollutants in reservoirs and the atmospheric air (G.N. Krasovskiy, N.G. Andreyevshcheva, and others). Studying the conformances to principle of the development of the toxidynamic process, investigated in short-term experiments on the basis of the relationship of dose--time--effect, makes it possible to accelerate greatly the conducting of experimental research on substantiating the permissible content of pollutants in the environment (G.I. Sidorenko; M.A. Pinigin and coauthors), due to which hygienic science has the opportunity of meeting life's requirements more promptly. Systems of quick experiments, based on new principles, have been suggested for this purpose.

In the last few years, hygienists, with the direct participation of biomedical specialists, are making an increasingly wide study and revealing more and more frequently the long-range results of the effect of many chemical substances (carcinogenic, embryotoxic, gonadotoxic, allergenic, mutagenic, etc.).

Along with the development of research directed toward studying the effect of individual environmental factors on morbidity, integral approaches are being successfully developed to studying the population's state of health, with the determining of the changes characteristic for prepathological states of the organism, for these are the changes that play a major role for hygiene. Closely connected with the study of prepathology are the problems of investigating the compensatory-adaptive mechanisms with exposure to unfavorable chemical, physical and biological factors in the environment and their various compounds. These studies, apparently, may serve as the starting point in predicting the possible morbidity of the population in connection with the effect of unfavorable environmental factors (G.I. Sidorenko, Yu.I. Prokopenko, etc.).

In the last few years, under laboratory and natural conditions (epidemiological studies) the role of sulfur dioxide and phenol as factors stimulating pulmonary carcinogenesis has been established; the mutagenous activity and gonado- and embryotoxic effect and allergenic effect of small doses of a number of chemical substances have been studied. New methods have been worked out to evaluate the reflex action of chemical atmospheric pollutants on the bioelectrical activity of the brain (method of induced potentials , reaction of rhythm rearrangement) and behavioral reactions (A.I. Bokina, M.Kh. Khachaturyan and others).

A number of comprehensive works have been done on evaluating the effect of the discharges of key industrial sectors on the state of the atmosphere, living conditions and the health of the population. Particularly, studies were large industrial complexes for petroleum refining, petrochemistry and

the construction industry (M.I. Gusev, M.S. Sadilova, and others). A study was also made of the effect of transport (motor vehicle, aviation and marine) on the state of the environment, living conditions and the population's health, and hygienic recommendations were drafted for the most efficient, urban development, technical and technological designs (Yu. G. Fel'dman, V.A. Gofmekler, and others). Among the natural studies, a particularly interesting one is the basic work on studying the cycle of carcinogens in the environment and the conditions for their entering the organism. Using three cities as an example, a study was made of the content of carcinogens in the air, soil, drinking water and vegetables, which made it possible to estimate the actual doses of their entering the organism (N.Ya. Yanysheva, and others).

Among the most important achievements, note should also be made of the comprehensive studies on the development of new GOST [All-Union State Standard] for the quality of drinking water and selecting the sources for household-drinking water supply, particularly GOST 2874-73, "Drinking Water," and GOST 18963-73, "Drinking Water. Methods of Sanitary-Bacteriological Analysis" and 17 chemical-sanitation standards for "Drinking Water. Methods of Determining the Chemicals in the Water." A new GOST was prepared and approved on selecting sources of household-drinking water supply. New "Regulations on Protecting Surface Waters From Pollution by Sewage" were drafted and approved, which considerably strengthened the hygienic position of sanitation protection of reservoirs (S.N. Cherkinskiy, Ye.P. Sergeyev, and others).

A cycle of major works was completed on the hygienic evaluation of new methods of obtaining drinking water by desalting various saline and subsaline waters. The norms for minimal, maximal and optimal levels of over-all mineralization and calcium content in desalted drinking water were substantiated (G.I. Sidorenko, A.I. Bokina, Yu.A. Rakhmanin and coauthors).

Extensive full-scale studies of the sanitary state of reservoirs and an analysis of the perspectives for the development of the national economy made it possible to work out hygienic substantiations for the Master Plan for Comprehensive Use and Protection of Water Resources of the USSR. Specifically, recommendations were established to protect the basins of the Volga and Ural rivers, the protection and comprehensive use of the fourth section of the Karakum Canal, the Ust'-Ilimskoye, Saratovskoye, Dnepropetrovskoye, Krasnodarskoye and other reservoirs (Institute of General and Communal Hygiene imeni A.N. Sysin of the USSR Academy of Medical Sciences, the Kiev Scientific Research Institute of General and Communal Hygiene imeni A.N. Marzeyev, the Moscow Scientific Research Institute imeni F.F. Erisman, etc.).

Work was begun for the purpose of scientific substantiation of measures for the sanitation protection of coastal seas. New interdepartmental "Regulations of the Sanitation Protection of Coastal Waters of the Seas" were established and approved (V.G. Subbotin, and others).

Scientifically substantiated for the first time were the principles of hygienic norm-setting for chemical pollutants of the soil, and "Provisional Methodological Directives for Establishing the Maximal Permissible Concentration of

Chemical Substances in the Soil (Ye.I. Goncharuk, V.M. Perelygin and others). The first hygienic norms for 7 chemicals have already been approved by the USSR Ministry of Health. A study has been made of the effect on the soil, vegetation and ground waters of the discharges and wastes from a number of industrial enterprises and sludge storages, and the appropriate recommendations for sanitation control have been drafted.

There has been scientific substantiation of the predictions for settlement, housing construction, the sanitation state of the atmospheric air, the water resources in the country and the soil for the near and more long-term future, as well as of the prediction of scientific research in the sphere of environmental hygiene, which have been included in the draft of the scientific-technical prediction for environmental protection of the State Committee on Science and Technology of the USSR Council of Ministers, and are being used to work out recommendations for the reorganization of the urban environment of 26 major cities in our country. The "Methodological Directives for the Organization of State Sanitation Supervision of the Development and Execution of Systems of Rayon Planning" have been drafted and approved by the USSR Ministry of Health, and they are being used for hygienic substantiation of the master plans and plans for the regional layout of newly developed and reconstructructed territories in the country, particularly in the region of the Amur-Baykal Trunkline.

New norms were substantiated for the microclimate and air exchange in housing and public buildings and medical institutions in various natural-climatic zones, in consideration of the age characteristics of the population, and for hospitals with various types of pathology. A new section of the SNiP [Construction Norms and Regulations] was prepared for artificial lighting of medical-prophylactic institutions, and in conjunction with a technical institute, special fluorescent lamps were designed for medical-diagnosis offices. In consideration of extensive sociological-hygiene studies, the optimal measurements were substantiated for the housing area for the future (N.M. Dantsig, Yu.D. Gubernskiy, Ye.I. Korenevskaya, and others). It was proven that suberythematous doses of ultraviolet radiation increase the adaptational and compensatory potentials of the organism (Yu.I. Prokopenko, A.P. Zabaluyeva).

The USSR Ministry of Health drafted and approved "Provisional Methodological Directives for the Hygienic Evaluation and Sanitation Control of the Storage and Sale to the Population of Household Chemistry Objects," as well as the "Provisional Methodological Directions for the Evaluation of Materials Processed by Impregnating Synthetic Resins and Other Chemical Compounds" (K.A. Rapoport; A.I. Sautina and coauthors). The hygienic evaluation of about 500 samples of polymeric materials was obtained; in the process of the work about 60 percent of the samples obtained were declined, including those declined because of the carcinogenic danger of some of the ingredients of household chemicals.

A study of the conformances to principle of the circulation of pathogenic and sanitation-significant bacteria and viruses in environmental objects determined the need for the substantiation of new criteria, used in a number of normative documents, of the epidemic danger of waters with varying degrees of pollution. The basic conformances to principle were determined for the effect of chemical and physical factors of the environment on the active life of intestinal and respiratory viruses, pathogenic enterobacteria and sanitation-significant organisms (G.A. Bagdasar'yan, Yu.G. Talayeva, L.Ye. Korsh, and others). For the first time, studies were made of the hygienic aspects of using bdellovibrio a bacteriovirus as a biological indicator of the processes of self-purification of polluted waters, in relation to pathogenic bacteria and viruses of the intestinal group (G.I. Sidorenko, G.A. Bagdasar'yan, and others).

An intensive study is being made of the effect on the population of city noise, in consideration of the impulse nature and norm-setting for it (I.L. Karagodina, S.A. Soldatkina). The USSR Ministry of Health drafted and approved "Methodological Directives on Supervising the Fulfillment of Sanitation Norms for Permissible Noise in Housing and Public Buildings and on the Territory of Housing Construction," and "noise charts" were compiled for a number of cities in the RSFSR, the Ukraine, Central Asia and the Baltic States.

For the first time a study was begun of the biological effect of electromagnetic fields of radiofrequencies under conditions of population centers, and their influence on the health of the population, which made it possible to work out the appropriate norms and sanitation regulations for the location of radio transmission facilities in cities (M.G. Shandala, Yu.D. Dumanskiy). The biological action and effect on the population of accelerations and vibrations caused by municipal transport is being studied for norm-setting.

The present stage in the development of hygienic science is characterized not only by the further natural differentiation of hygiene into particular sections: communal, work hygiene and occupational diseases, nutrition, hygiene for children and adolescents, railroad and water transport and others, but also by the integration of certain bases of hygienic knowledge by general hygiene, or, as it is now more correctly called, environmental hygiene. This contributed to the development of research on the fundamental directions of hygienic science.

The achievements of Soviet scientists studying the problem of the "Scientific Bases of Environmental Hygiene" are recognized not only by the specialists of the countries of the socialist commonwealth, but also by the scientists of the developed capitalist countries (United States, France, Canada, etc.), with whom successful scientific collaboration is being implemented, as well as by the World Health Organization.

Even a brief enumeration of the major hygienic work already indicates that the specialists working on environmental hygiene understand their tasks and will devote all their efforts in fulfilling and overfulfilling the grand plans outlined by the 25th CPSU Congress.

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ATMOSPHERIC AIR SANITATION IN THE USSR

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 26-29

[Article by Professor K.A. Bushtuyeva, Central Institute for the Advanced Training of Physicians, Moscow]

[Text] The Soviet Union has entered the period of advanced socialism. Our country's national economy is developing on the basis of combining scientific-technical progress with the advantages of the socialist system. The effect of scientific-technical progress on the environment is taking place with the mediation of technology and the organization of labor. Because of this, the protection of the atmospheric air, just as the entire problem of environmental protection, is socially determined, and the potentials for solving are directly related to the socio-economic formations of society. This also determines the unique nature of the problems of atmospheric air sanitation in the USSR.

Since the first years of the existence of the Soviet state, solving the problems of atmospheric air protection has been regarded as an integral part of the work of the party in protecting the workers' health. This was specifically expressed in the party program adopted at the 8th Congress of the Russian Communist Party (of Bolsheviks) in March 1919. Despite the difficult period in the country, by the end of the 1920's studies had already begun to be made in atmospheric air sanitation. In 1935 scientific conferences on protecting the purity of the atmospheric air had already begun,* which indicated the appearance in our country of atmospheric air sanitation as a science. It should be emphasized that this sphere of communal hygiene appeared and was particularly developed in the USSR, while abroad these problems began to be paid attention only much later.

Of great importance in the development of atmospheric air sanitation in our country was the period after the Great Patriotic War. A definite role was played in this by the Decree of the USSR Council of Ministers "On Measures To Combat the Pollution of Atmospheric Air and On Improving the Sanitation-Hygienic Conditions of Population Centers," of 29 May 1949, which forced

* Gol'dberg, M.S., GIGIYENA I SANITARIYA, No 11, 1967, pp 23-27.

the industrial ministries and departments to take the necessary measures to protect the atmosphere and laid the foundation for carrying out planned and compulsory measures for the sanitation protection of the air of the country's population centers. This decree determined the specific tasks of the USSR Ministry of Health, the chief of which consisted of the development and scientific substantiation of the maximum permissible concentrations of atmospheric pollutants and an evaluation, on their basis, of the degree of danger of atmospheric air pollution.

In these years criteria were formulated for the harmfulness of atmospheric pollution (V.A. Ryazanov)*, which served as the basis in principle and theory for establishing the maximum permissible concentrations. By 1951, maximum permissible concentrations for the 10 most widespread atmospheric pollutants had been approved as all-union norms in the USSR. The Soviet Union became the only country in the world where the implementation of measures to combat air pollution was based on hygienic norms for the quality of the air. In the 1960's the USSR already had considerable experience in hygienic norm-setting for atmospheric pollution (over 100 substances) both in isolation and in the joint presence of a number of them, while abroad the first norms for single atmospheric pollutants were just beginning to appear. This situation still remains in all the capitalist countries.

It must be emphasized that the advantage of Marxist-Leninist methodology has been clearly demonstrated in the sphere of sanitation norm-setting. Soviet hygienists, in studying the biological effect of atmospheric pollution, use an experimental method that makes possible a considerable increase in the efficiency of this action, as compared with the method of observation that is primarily inherent in studies of the sanitation of atmospheric air in the capitalist countries. The use of the experimental method, which makes it possible to form a model study of the given conditions and give a broad summarization of the results in order to predict the biological effect of atmospheric pollution, has determined the differences in principle and the advantages of scientific research in atmospheric air sanitation in the USSR.

At the same time, in the last 10 years, particular interest both in our country and abroad is being shown in the problem of protecting the environment, and particularly, the atmospheric air. An indication of this is the Appeal of our government "To the Peoples of the World" (22 December 1972), which says: "The struggle against the danger involved in the increasing deterioration of natural conditions of the poisoning of the air, seas, and rivers and pollution of cities is becoming increasingly important for mankind." The need to carry out more widespread health-improvement measures and the specific directions of work in environmental protection were particularly served at the session of the USSR Supreme Soviet in September 1972. On 29 December 1972 a special Decree of the CPSU Central Committee and the USSR Council of Ministers was carried out "On Measures for Nature Conservation and Efficient Use of Natural Resources." This problem was particularly covered in the Materials of the 24th and 25th CPSU congresses.

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* Ryazanov, V.A., GIGIYENA I SANITARIYA, No 6, 1961, pp 3-8.

The objective reason for this attention to the problem of environmental protection is the period of scientific-technical progress (NTP) experienced. NTP is rapidly changing the structure and scale of industrial production. The change in the production structure is taking place due to drawing into man's economic work increasingly new natural elements and new synthetic compounds, created on the basis of achievements of organic synthesis.

For example, while during the first half of the twentieth century, the number of natural chemical elements used rose from 19 to 49, during the 20 years of the second half of the century it reached over 100, because of which the composition of the polluted atmospheric air grew increasingly complex--appearing in it were compounds of nonferrous metals, rare and trace elements, with which man had not yet come into contact in the first half of the century. Also encountered in the composition of the atmospheric pollution are new synthetic compounds, yearly created by man by the hundreds as the result of NTP. It should be added that the level of our knowledge has also increased with respect to the appearance in the atmosphere of the products of transformation of primary pollutants, the toxicological nature of which may differ substantially from the initial products.

Along with the change in the qualitative composition of atmospheric impurities, consideration must also be made of the changes in their quantitative composition in connection with the increase in the scale of industry. The intensification of production and the increase in labor productivity on the basis of automatation and mechanization makes it possible at the same production areas to design an industrial enterprise output considerably nore powerful in volume which may entail an increase in the emissions, unless prompt and efficient neasures are adopted to protect the atmosphere. The changes in the structure and scale of industrial production require that new data be accumulated on the evaluation, and in a number of cases on the reevaluation of sanitation situations and the expansion of scientific research on the sanitation of atmospheric air as a whole. "The scale of economic operations in the Tenth Five-Year Plan and the specific nature of modern technological processes, used in industry, particularly in such sectors as metallurgy and chemistry, necessitate special measures to protect the environment," noted A.N. Kosygin at the 25th CPSU Congress.

One should also bear in mind the intensification and expansion of our knowledge and ideas on the biological effect of atmospheric pollutants and the possible unfavorable consequences that may occur both for the living population and the future generations. It should be emphasized that a large role was played in recognizing the seriousness of the problem for mankind by the works of Soviet hygienists, experimental studies on revealing the conformance to principle of the biological effect of small concentrations of chemicals under the conditions of inhalation exposure and the study of the characteristics of the reflex reactions with brief inhalation, as well as the characteristics of nonspecific changes with prolonged resorptive action. Great attention was paid to determining the far-reaching consequences--the embryotoxic and gonadotoxic action of atmospheric pollution. In addition to

studies in a chamber, the presence of these effects was confirmed in animals under natural conditions that had been exposed at varying distances from industrial enterprises, as well as by the study of the specific functions of the female organism on the basis of an investigation and analysis of birth history. The rise in the number of allergic diseases in the population required that an experimental study be made of the sensitizing action of atmospheric pollutants. The studies confirmed the presence of a definite relation between the frequency of diseases of allergenic genesis and the degree of air pollution. It should be emphasized that the sensitizing effect of certain atmospheric pollutants is shown at concentrations lower than the threshold of the general toxic effect.

Domestic studies of the carcinogenic effect of substances have been substantially expanded and deepened, and for the most widespread, benzpyrene, the maximum permissible concentration was established on the basis of experimental data on the relationship, dose--time--effect, and the extrapolation of the data for man, using the probability theory in evaluating the risk of tumors occurring. A study was made of the role of toxic substances in increasing sensitivity to the induction of tumors in descendants, as well as the possible carcinogenic effect of atmospheric pollution.*

Characteristic of the research of the last few years was the expansion of the study of the biological effect of aerosols of metals and the substantiation on this basis of the maximum permissible concentration for a number of them (zinc, copper, cobalt, nickel, selenium, tellurium, etc.). The list of the maximum permissible concentrations has also been supplemented with new organic and synthetic compounds. All this makes it possible to develop and implement, on a scientific basis, purposefully and efficiently, measures to protect the air of the atmosphere from pollutants.

Along with the unquestionable progress in the sphere of sanitation of the atmospheric air, there are still problems, the solution of which requires the combined efforts of hygienists and practical public health physicians. This is particularly true of the need to expand the study of the effect of air pollution on living conditions and the population's health. Multicomponent pollution of the atmospheric air, even in relatively low concentrations, is inherent under today's conditions. At the same time, the nature of the effect on the organism of certain substances, for example, metal aerosols, which are bioelements, changes, depending on the combined presence of a number of them, the ratio of individual metals, the level of concentration of each, etc. All of this, along with the need for experimental study, increases the significance of determining the effect of complex natural situations on the standard of living and the population's health.

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* Bushtuyeva, K.A., "Results and Perspectives of Hygienic Norm-Setting for Atmospheric Pollutants," Theses of Reports of the 26th All-Union Congress of Hygienists and Public Health Physicians," Moscow, Meditsina, 1972.

A principal and distinctive feature of air sanitation in our country is its integral tie with practical work, with the country's national economy. The short-term and long-term planning of its development, characteristic only of a socialist state, already necessitates the determination of sanitation requirements for the distant future, which will contribute to solving the problem of air pollution. Because of this, predictive estimates of the pollution level and their sanitation evaluation is becoming increasingly important. This is posing a real task in our country, both with respect to the evaluation of the potential danger of possible pollution (when the evaluation of the biological effect outstrips the introduction of new compounds in production) and in designing mathematical models to predict future pollution. While 10 years ago such studies were limited only to estimating high and heated atmospheric emissions, since 1975 sanitation legislation has included the method of estimating both heated and cold emissions at various heights (SN 369-74), which substantially increases the reliability of evaluating the preplanning and planning studies to protect the air basin.

The USSR has all the prerequisites for a successful solution to the problem of air pollution. Only in a socialist country is it possible to carry out such state measures as planned distribution of production forces, allowing for environmental protection, restricting the growth of large cities and widescale introduction of special measures for air protection. All these problems were formulated particularly clearly in the materials of the 25th CPSU Congress. The principal task of hygienists and public health physicians should be considered to be increasing the efficiency and raising the quality of scientific research and expanding practical work in air sanitation.

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60 YEARS OF DEVELOPMENT OF FUNDAMENTAL DIRECTIONS FOR RESEARCH IN THE SANITATION PROTECTION OF RESERVOIRS

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 30-35

[Article by S.N. Cherkinskiy, corresponding member of the USSR Academy of Medical Sciences, Moscow Medical Institute No 1 imeni I.M. Sechenov]

[Text] Socialism, it is noted in the Decree of the CPSU Central Committee "On the 60th Anniversary of the Great October Socialist Revolution," created unlimited possibilities for the development of science. Only under socialism were the conditions created for the use of the achievements of science in the interests of the workers, and due to this Soviet scientists may make a huge contribution to the cause of building communism. Our science serves high humanitarian goals, in contributing to the solution of the major problems that worry all nations, including environmental protection. The most important part of the latter problem is sanitation protection of reservoirs (SOV).

After the Great October Socialist Revolution, the effect was noticed of the attention that V.I. Lenin had paid to preventive public health, problems of hygiene and practical work in sanitation. The ideas of Vladimir Il'ich were clearly reflected in the program of the Russian Communist Party (of Bolsheviks), developed under its guidance and adopted by the 8th Party Congress in 1919. On the initiative of and signed by V.I. Lenin, a number of decrees were issued, in accordance with which measures were taken that played a large role in eliminating the republic's sanitation troubles, particularly in the sphere of water supply, sewage and SOV. In 1922, the decree of the RSFSR Soviet People's Commissariat on the republic's sanitation organs for the first time defined the state significance of sanitation work directed toward implementing the broad sanitation measures, including those for water supply and SOV, in which environmental pollution had first of all appeared. Competent practical and scientific institutions were established that considered protecting and improving the environment a state affair, and this took place 50 years before the attention of advanced scientists and public figures in the West was drawn to the social aspects of protecting nature.

The potentials that have appeared under Soviet power for state control of sanitation protection of reservoirs necessitated special legislation, the first document of which was the "Regulation on Norms for Sewage Purity" (1923), recalling the recommendation of G.V. Khlopin. It appeared despite the fact that the congress set up by the People's Commissariat of Public Health on problems of rehabilitating and improving the sanitation conditions of cities and industrial regions (1921) acknowledged that the criterion for judging the quality of SOV should be the composition and properties of the water in the reservoirs below the draining of the sewage. True, the regulation permitted a deviation from the recommended standard for the purity of the sewage, if the need or expediency of such a deviation was confirmed by the results of local sanitation investigations. This reflected the influence of the consolidated positions of the opponents of standardizing the requirements for the composition of sewage. As a result of the limited nature of the experiment and the inadequacy of the scientific observations, however, many more years were needed for rational bases for regulation (control) of the drainage of sewage into reservoirs to be generally recognized and put into sanitation practice.

A large role was played by the progress in fulfilling the first five-year plans for industrialization of the country, which posed new and more complex tasks for hygienic science and sanitation practice. Under these conditions the RSFSR Council of People's Commissars (1927) prepared and approved the Decree "On Ratifying the Position of the Republic's Sanitation Organs," which, along with the expansion of the current sanitation supervision, for the first time in world practice established compulsory and permanent state preventive health supervision. It became increasingly obvious that under the new conditions an approach, new in principle, was required for the solution of the basic problems of sanitation practice, including sanitation protection of reservoirs.

The accumulated experience and progress in the theoretical elaboration of the problem, along with the many years study of the sanitary condition of the reservoirs, widely organized at the end of the 1930's under the direction of the Central Institute of Communal Hygiene, proved convincingly that, with the solution to the problem of the admissibility and conditions of discharging sewage into the reservoirs, the basis should be the requirements for the composition and properties of the latters' water. The USSR proved to be the first country in which these aims were decisively adopted in the theory and practice of sanitation protection of reservoirs, which served as the origin of the present stage of development of hygienic science and water-sanitation legislation on a basis new in principle. This was also expressed in the new rules for discharging sewage into reservoirs (OST [All-Union Standard] 9014-39), which had already formed the basis for standardizing the composition and properties of the water in reservoirs in direct accordance with the varied nature of their use by the population (household-drinking, cultural-everyday, etc.). This progress proved to be important not only in itself, but also because it afforded opportunities for further unprecedented rapid and multifaceted development of the theory and practice of the Soviet SOV.

For example, because of the varied nature of water usage, not only by the population, but by the sectors of the national economy, the need arose for mutual coordination of scientific and practical work in SOV. This was achieved at a broad interdepartmental conference in Moscow (1944), at which it was acknowledged that the SOV problems should be considered from the standpoint of the social significance of the problem, which was especially necessary in the interests of the population's health. The priority of the interests of the population's health was subsequently confirmed in the "Fundamentals of Legislation on Public Health" (1969) and the "Fundamentals of Water Legislation" (1970).

It was also accepted that the changes in the composition and the properties of the water in the reservoirs that had taken place due to the discharge of sewage did not yet in themselves determine the harmful nature of the sewage, if only these changes did not violate safe and expedient water usage. In consideration of the fact that there could be no single criterion of the harmfulness of sewage, since the nature of the water usage varied (drinking, cultural-everyday and various national economic needs), it was recognized to be inevitable and expedient to differentiate the methods of studying and determining special requirements for the quality of the water in the reservoirs, depending on the special features of the water usage.

For a scientifically substantiated solution to the problem of the admissibility of discharging sewage into the reservoirs and including specific reservoirs or sections of them among those needing priority protection against pollution, maximal permissible concentration norms were adopted for household or industrial pollution, which were also to correspond to the characteristics of the type of water usage (drinking, cultural-everyday, fishery, etc.).

Many further years of practical work confirmed the correctness and expediency of the above regulations. The law "On RSFSR Nature Protection" and the Decree of the USSR Council of Ministers "On Regulating the Use and Protection of Water Resources," issued in 1960, were of decisive importance. Through them, norms for water-sanitation legislation were adopted for the first time as a state regulatory factor, and their drafting in accordance with the principle of differentiation was entrusted separately to the USSR Ministry of Health and other ministries.

The principle of a differentiated approach to setting norms for pollution of reservoirs, as applied to individual types of water usage, not only aroused no opposition or difficulties with simultaneous use of the reservoir, but on the contrary, created the conditions for complete harmony of interests of all the water users in any specific circumstance. This was achieved due to the fact that, in the "Regulations for Protection of Surface Reservoirs Against Pollution by Sewage" (1961), it was already specified that in each specific case, when using a reservoir or part of it simultaneously for different purposes, the conditions for discharging the sewage into this reservoir should correspond to the type of water usage, the protection of which

required adherence to stricter norms. Therefore, the principle of differentiation in SOV was successfully combined with the comprehensive nature of the entire problem, which was determined by the broad and varied use of the water resources.

The principle of differentiation was also firmly put into effect by Soviet legislation, for example, in the decree of the CPSU Central Committee and the USSR Council of Ministers (1972), which was one of the major documents of the last few years on the SOV problem. In accordance with the directives of the 24th Party Congress on the importance of comprehensive use of the country's water resources, this decree stipulates the differentiation of the assignments for the USSR Ministry of Health, the USSR Ministry of Fish Industry, the USSR Ministry of Land Reclamation and Water Resources and the Main Administration of Hydrometeorological Service of the USSR Council of Ministers, according to the nature of their work.

The value of the principle of differentiation with respect to SOV also had its effect in the recognition of the need for norms corresponding to the special conditions of each type of water usage individually. This contributed to the fact that Soviet hygiene institutions focused attention on the scientific substantiation of norms in accordance with their jurisdiction and corresponding to the interests of preventive public health. At the same time, the scientific institutions serving other sectors of the national economy were afforded the possibility of drafting, no less competently, special norms in the interests of these sectors. The scientific institutions of the Ministry of the Fish Industry solved this problem with relative success.

Scientific substantiation of hygienic norms acquired the significance of a central unit in the strictly SOV system; the research in this sphere is among a number of extremely important studies planned by the State Committee on Science and Technology of the USSR Council of Ministers. In actuality, the enrichment of water-sanitation legislation with hygienic norms--maximum permissible concentrations--gives to preventive sanitation supervision a specific nature and intensifies the effect of hygienic science and sanitation practice on the efficiency of the sanitation-technical and technological measures implemented for reducing reservoir pollution. Due to the possibility of using hygienic norms, practical significance was acquired for the first time by the numerous studies of the sanitation state of reservoirs, since the comparison of the data obtained with the norms made it possible to draw valid conclusions as to the general state of the reservoirs and the efficiency of the measures being taken for their sanitation protection. The norms, for the first time in hygienic science and sanitation practice, created the basis for a scientifically substantiated prediction that is becomingly increasingly urgent under the conditions of scientific-technical progress.

At the end of the 1940's, basic tasks were formulated and a methodological system was worked out for hygienic norms for SOV, which became generally recognized in studies for the purpose of scientific substantiation of the maximum permissible concentration (Department of Communal Hygiene of Moscow

Medical Institute No 1 imeni I.M. Sechenov).* According to the system, the ascertaining and scientific substantiation of the hygienic norms are multiplanar and comprehensive experimental studies, supported by basic biological conformances to principle. The effect of the chemical factor acting on the organism is proportional to its strength, and the effect of the external factor of the environment on the organism is subordinated to the principle of the threshold element. The development of research on hygienic norm-setting was furthered by the need, recognized by Soviet hygienists during these years, to reorganize hygienic science on a physiological-hygienic basis and the teachings of I.P. Pavlov on the inevitability and primary importance for medicine of the experimental method, which justified the use of the method of model study of actual conditions of the effect of environmental pollution in experimental studies on hygienic norm-setting.

From the very beginning, when the methodology was formulated for studies on hygienic norm-setting in SOV, at all stages of the experimental work, its formulation, carrying out and interpretation of the results, it was considered compulsory to exclude completely elements of libertarianism. This was a commitment to using methods corresponding to the current level of knowledge and to careful consideration of the functional changes in the organism, individual organs and systems through applying the most efficient physiological and biochemical methods, particularly of an integral nature (conditioned reflex, immunological). Great attention was paid to choosing the length of the experiment, control of the initial state of the organism and consideration of the physiological fluctuations in the functions of the organism being observed.

The use of a broad spectrum of study methods and of the most adequate characteristics of chemical contaminants made it possible to detect concentrations not only dangerous for the organism but also those that could be included among the inactive ones, for their effect was not detected even with the most sensitive tests. On the basis of the results obtained, the levels of harmlessness could be determined and used to substantiate the maximally inactive concentration. Comparison with two other indices of hazard (organoleptic and according to the sanitation state of the reservoir) gives a substantiated value for the maximum permissible concentration in accordance with the limiting index of the hazard. The experience acquired and the experimental methodological studies made it possible to compile on an expanded basis and to publish the new "Methodological Directives for the Study and Scientific Substantiation of Maximum Permissible Concentrations of Harmful Substances in the Water of Reservoirs."** They will contribute to raising the scientific level of the research done and greater reliability of the recommended maximum permissible concentration. This is especially important, since studies on hygienic norm-setting are carried out by many

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* Edited by S.N. Cherkinskiy, Moscow, 1976.

** "Sanitarnaya okhrana vodoyemov ot zagryazneniya promyshlennymi stochnymi vodami" [Sanitation Protection of Reservoirs Against Pollution by Industrial Sewage], edited by S.N. Cherkinskiy, Moscow, Medgiz, 1949.

institutes and departments with a specialty in hygiene, according to the materials of which the USSR Ministry of Health in 1977 confirmed the maximum permissible concentration of over 550 specific industrial pollutants of reservoirs.

The above methodological system for hygienic norm-setting specifies as the concluding stage carrying out full-scale inspections in order to ascertain the possible effect of the substances studied on the health and sanitary living conditions of the population. The possibility of implementing this, however, increased considerably due to the progress in experimental research. Since it is recommended that full-scale studies be made after the maximum permissible concentrations of the pollutants are known, and thus their limiting indices of harmfulness are known, the nature of the possible unfavorable effect of these pollutants is also suggested. Moreover, with the most dangerous sanitation-toxicological index of harmfulness, the limiting test is already known, in other words, the organs and systems that may be affected first. Unfortunately, the possibility under these conditions of purposeful, and thus, more efficient study of the morbidity of the population in industrial regions in consideration of the water factor is not yet utilized sufficiently.

It should be noted that in hygienic norm-setting as applied to SOV, the process is observed of continuous expansion and improvement of the methodological devices of setting up all, and particularly sanitation-toxicological experimental studies.* This was shown particularly in the course of the last decade in connection with the recognized need to take into consideration the long-range consequences of the effect of chemicals on the organism. Especially needed was a study of the effect of chemicals on the reproductive function, to which is related the mastery of methods of studying the functional state of male and female gonads, the mutagenous, and in a number of cases also the embryotoxic and teratogenic effect of chemicals. In the studies of the last few years, because of the great labor-intensiveness of ascertaining the blastomogenic effect of chemicals, it was as a rule customary to analyze carefully the data of specialized literature to discover whether the substance being studied was included in groups characteristic for chemical terminogenesis. Until recently, as was true with respect to 3,4-benzpyrene, studies on the hygienic norm-setting of substances dangerous because of blastomogenic effect were made primarily at the facilities of special laboratories.

There is an increasing need to study the allergenic properties of chemical water pollutants. So far, however, the experience in physiological and hygienic interpretation of the results obtained when these substances are received perorally in the organism is still very limited.

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* "Sanitarnaya okhrana vodoyemov ot zagryazneniya promyshlennymi stochnymi vodami" (1949-1960) and "Promyshlennyye zagryazneniya vodoyemov" [Industrial Pollutants of Reservoirs] (1967-1969).

Considerable progress has been achieved in studies that expand and give greater depth to theoretical and methodological ideas in hygienic norm-setting. For example, the use of the maximum permissible concentration was substantiated for hygienic norm-setting under the conditions of simultaneous (combined) pollution of reservoirs by several harmful substances, and the role of species sensitivity in hygienic norm-setting and rightfulness of extrapolation of experimental data from animals to man were ascertained, and the possibility was shown of using the phenomena of isomerism and homology in hygienic norm-setting for organic substances.

At the same time, a more precise conception was gained of the criteria of danger and the threshold of effect of chemical substances: the concept and potential for quantitative evaluation of the ability of the substances to accumulate in the organism were revealed. Studies were made of the characteristics of the comprehensive action of chemicals on the organism and the combined action on it of chemical and physical factors, as well as the role of adaptation in hygienic norm-setting and many other problems.

Studies made in the last 10 years of methods for the experimental and mathematical prediction of toxicity levels are becoming particularly important. The "Fundamental Directions for the Development of the USSR National Economy in 1976-1980" specially indicate: "Improve the methods of predicting the effect of production on the environment and take into consideration its possible consequences when preparing and making planning decisions." Since experimental studies in hygienic norm-setting, as was noted, make it possible to foresee the degree of harmfulness and the level of harmlessness necessary for hygienic norm-setting, the predictive significance of hygienic norms (maximum permissible concentration) is obvious.

The length of the experiments to substantiate the maximum permissible concentration do not exceed the ordinary periods of new technological developments, but nevertheless, with the increasing rates of scientific-technical progress, acceleration is also often required of the process of hygienic norm-setting. Appearing promising in this respect are calculation methods of predicting, on the basis of an analysis of already accumulated experimental data on substantiation of maximum permissible concentrations, and determining the coefficients of correlation between the toxicological parameters (for example, LD_{50}) and the hygienic norms for substances that are similar in their physical-chemical properties,* Although the calculation methods do not replace experimental studies, they help to accelerate carrying them out, and the results may be used as rough norms when a rush preliminary decision is required.

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* Krasovskiy, G.N., "Methods of Prediction and Calculation of Sanitation-Toxicological Parameters," TRUDY I MMI IMENI I.M. SECHENOVA, Vol 54, Moscow, 1971.

Moreover, using the established maximum permissible concentration, allowing for hydrological and hydrodynamic conformances to principle has made it possible to create a mathematical model depicting the relations of the source of the pollution, the background state of the reservoir and the characteristics of its hydrological conditions, and making it possible, with the aid of the calculation method, to solve varied problems of prediction--from determining the degree of danger of the reservoir's pollution and the necessary amount of measures to make the sewage harmless to long-range prediction on the scale of river basins when working out local and general systems for the protection of natural resources. The calculation methods of predicting the sanitation state of reservoirs, as applied to the most frequent cases of practical work, were included in the "Methodological Directives for State Sanitation Control Organs in Using the New 'Regulations for Protection of Surface Waters Against Sewage Pollution'" (1974), issued in 1977 by the USSR Ministry of Health.

Granted the very inevitably approximate nature of experimental, and especially of the calculation method of predicting the harmlessness of industrial pollution and the sanitation state of reservoirs entered by the sewage with the current, the degree of reliability of these methods depends on their further improvement, the need for which is justifiably emphasized in the materials of the 25th CPSU Congress.

Therefore, progress in hygienic norm-setting as an extremely important direction in research in SOV made it possible to prepare practical work in sanitation for the maximally possible utilization of the directives of the 25th Party Congress on the importance of predicting the effect of production on the environment and, naturally, on the sanitation condition of the water resources and take into consideration the possible unfavorable consequences with a sanitation expert examination of the planning decisions. These achievements, made by the 60th anniversary of the Great October Revolution, are the result, in conformance with principle, of the progress of Soviet hygienic science, in combination with the tremendous progress in the development of the national economy and the entire country's culture.

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SYSTEMS FOR COMPREHENSIVE USE AND PROTECTION OF WATER RESOURCES AS A FORM OF STATE REGULATION OF SANITATION CONDITIONS FOR WATER CONSUMPTION BY THE POPULATION IN THE FUTURE

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 35-38

[Article by A.P. Shitskogo, corresponding member of the USSR Academy of Medical Sciences, K.I. Akulov, RSFSR deputy minister of health, RSFSR Chief State Public Health Physician, Professor L.S. Gurvich, Yu.V. Novikov, doctor of medical sciences, and V.A. Savelova and S.I. Plitman, candidates of medical sciences, Moscow Scientific Research Institute of Hygiene imeni F.F. Erisman]

[Text] In the process of carrying out the decisions of the 25th CPSU Congress, there is broad drafting of comprehensive programs for the development of various sectors of the national economy, and the productive forces of new regions of the country, rich in raw materials and power resources, are being developed. Particular attention in this case is being paid to the efficient use of raw material resources, protecting the environment and making predictions for the future. An important place is occupied by the problem of comprehensive use and protection of water resources, which to a considerable extent determines the sanitation of the population's living conditions and its health for the future.

Hygiene institutions have accumulated definite experience from direct participation in this work, being carried out on assignment of the State Committee of the USSR Council of Ministers on Science and Technology for a number of years by a large group of scientific research institutions with various specialties, including hygiene. In the process of the research, theoretical approaches were worked out to the scientific substantiation of the problem in the hygienic aspect and individual methodological procedures were approved. The content of the systems consolidated in our water legislation for comprehensive use and protection of water resources has gradually crystallized. The systems, as a form of state prediction of comprehensive use and protection of water resources, afforded the possibility of direct participation in their compilation of all the principal, concerned water consumers and organizations representing them, particularly hygiene institutions and sanitation organs, which have, according to our legislation, priority importance in protecting the population's health interests, as compared with other water consumers.

The systems being developed create a scientifically substantiated basis for the work of the health organs in the sphere of preventive inspection in the solution of problems of comprehensive water consumption and drainage, as well as in establishing the potentials and conditions for locating industry and other facilities at reservoirs, in consideration of the water factor. Experience has shown that the succession of developments--from the master plan to the local and to the individual specific plans--is the best way, from the sanitation standpoint, to solve the problems of efficient use and protection of water resources for the future. The participation of the hygiene institutions in the work of the planning organizations when the systems are compiled makes it possible, for hygienic purposes, to influence the solution of major national economic problems connected with long-range planning. At the same time, the studies of the sanitation state of the reservoirs themselves take on a new significance in principle, becoming an integral part of the systems being worked out for the future.

The basis for these studies, as is known, was laid in the 1960's with the compilation of the first master plan in our country for comprehensive use and protection of water resources. The participation in this work of a large collective of scientific research institutes of hygiene, departments of medical institutes and many epidemiological stations, joined by unified programs and systems of research, made it possible to gather a great deal of material on the sanitation characteristics of the country's reservoirs, which was widely used in drafting water protection measures for 1975-1980. Based on this experience, the studies then took the course of compilation of local systems for individual water basins (the Oka, Tom', Belaya, Chu, Ural, Kuban' and other rivers). Work is now continuing in order to compile both local systems and a master plan for the distant future.

Emphasis should first of all be placed on the most important circumstance from the hygienic standpoint: in evaluating both the initial and the future quality of the water in the reservoirs, hygienic norms were laid down by the planning organizations when compiling the systems. Experience showed that the criterion for the purity of the waters adopted by our legislation is an aggregate of qualitative indices that determine the safety and harmlessness of water and its suitability for the population, and the norms worked out on this basis and expressed in quantitative parameters create a scientific basis for evaluating the quality of the water and planning water protection measures.

The water basin taken by the planning organizations as the object of the prediction is also, from the sanitation standpoint, the most acceptable, since it furthers the possibility of establishing the interrelation between the sources of pollution of the water project and the water consumers, often located in different administrative rayons, and creates the conditions for the development of the necessary water protection measures for both the basin as a whole and for individual parts of it, often interconnected. At the same time, the basin principle, requiring the participation in the studies of many hygiene institutions located on the territory of the basin, necessitated unification of the programs and systems of research, work coordination, "linking-up" the materials accumulated, etc.

It should be taken into consideration that now, when the boundaries of water provision for the national economy and the population have been expanded, they often go beyond the limits of the river basin and the problem arises of transferring part of the flow of the rivers from one basin to another and the development of systems takes on an interregional nature. Still, the relatively small amount of experience accumulated by the hygiene institutions shows that in solving this problem, many hygiene problems arise that require scientific study, both in the places where the water is removed and on the line of the transferral and at the points where the water is received.

As experience has shown, the main content of the work of the hygiene institutions in compiling systems for comprehensive use and protection of water resources are the accumulation and analysis of initial data on the characteristics of the sanitation situation at the reservoirs: the dynamics of their sanitation state in the last few years, the sanitation consequences of discharging sewage into reservoirs and the hygienic efficiency of regulating the river discharge by creating artificial reservoirs.

Justification has been given for the systemic principle used by hygiene institutions in gathering and analyzing materials on the sanitation characteristics of reservoirs, when, as compulsory elements of the study for each section observed, information is included on the sources of pollution, the sanitary conditions of the water consumption of the population and the quality of the water. At the same time it was revealed that orientation toward integral indices of the water quality is not sufficient for planning water protection measures for the future, which as a rule require great differentiation. The question arises of the sanitation-toxicological characteristics of the reservoir in each section for observation on the basis of the levels of its pollution ascertained with respect to the key specific ingredients, consideration of the existing hygienic norms, the possibility of their combined action and the use when necessary of calculation methods in order to substantiate hygienically the necessary water protection measures.

Because of the mass nature and the great variety of the materials accumulated in individual works, punchcard forms of calculation and study have been used, and prove to be quite efficient for these purposes.

In the course of the research, the significance of dynamic data on the sanitation characteristics of the reservoirs was revealed. Usually encompassing a 5-10-year period, they made it possible to establish the tendency of the development of the processes, to evaluate the changes taking place in the quality of the water in the reservoirs and the sanitation conditions of the population's water consumption in relation to the water-protection and water-resource measures taken, to give an evaluation of their positive effect and to establish the negative factors and their causes in order to take into consideration all of these data when drafting the sanitation assignments for the future.

A large and important task of the hygiene institutions, when compiling systems for comprehensive use and protection of the water resources was the drafting of sanitation assignments for use in planning them. As experience showed, the range of these assignments was quite broad. They were based on objective sanitation data and made it possible to pose and solve positively the problems that went beyond the limits of the ordinary, traditional hygienic recommendations. Some of the most spectacular examples in this respect may be mentioned individually. Many years of study of the dynamics of the sanitation state of the Tom' River basin (Moscow Scientific Research Institute of Hygiene imeni F.F. Erisman, Department of Hygiene of the Omsk Medical Institute, Kemerovskaya Oblast Epidemiological Station) revealed that the sanitation state of it at the middle and lower flow could not be fundamentally improved (even with appropriate water protection measures carried out at individual facilities) without flooding. In accordance with this, the planning organization designed, with the development of a local system for the Tom' River basin, the construction of an artificial reservoir to supply, first of all, the needs of the population (the plan was approved by Gosstroy). The sanitation data gathered in respect to the Tom' River were also the scientific substantiation in solving problems of the potential and conditions for locating new reservoirs for production facilities at Kemerova.

The sanitation data accumulated in compiling the systems showed that as the result of the water protection and water management measures taken, the sanitation state of the reservoirs in many sections during the last few years improved or stabilized, despite the intensive growth of industry, agriculture and cities. At the same time, a number of unsolved problems were also revealed that are important in the hygienic respect and require an improvement in the planning and methods of sanitation study.

It should be noted that little research has yet been done to verify the predictions, worked out in compiling the systems, of the quality of the water in the reservoirs. Some works on studying the convergence of the calculation predictions with the results of the actual full-scale studies (for the Belaya River, for the reservoirs of the Estonian SSR, etc.) showed that, given the general relatively high convergence, some divergences are detected that are of important hygienic significance. When the water storage basins are designed, allowance is not always made for their possible negative sanitation consequences, particularly under the conditions of cascades, in connection with the characteristics of the hydrological state; this is also true of relatively small water storage basins that as a rule require an intensification of the water protection measures in construction and operation in case they are also used for household-drinking purposes.

The content of the hygiene research in working out systems for comprehensive usage and protection of water resources and the methodological procedures for carrying them out also need further improvement. So far they have been devoted mainly to the characteristics of the sanitation situation and do not include obtaining data on the effect of changes in it on the health and the morbidity of the population. The first attempts to expand the volume and

nature of the research in this direction were made only recently and need further scientific-methodological elaboration. The methods of investigation used in studying the sanitation situation at reservoirs also require further precise definition--development of improved laboratory-analytical procedures for gathering data, their automation and also the statistical study, analysis and generalization of the data obtained.

There is every basis to think that the experience accumulated by the hygiene institutions in compiling systems for comprehensive use and protection of water resources will make possible its active participation in a further improvement in studying the major national economic problems advanced by the 25th CPSU Congress.

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THE DEVELOPMENT OF STUDIES ON THE HYGIENE OF USING POLYMERIC MATERIALS IN CONSTRUCTION AND EVERYDAY LIFE

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 39-42

[Article by Professor A.N. Bokov, Department of Communal Hygiene of the Rostov Medical Institute]

[Text] Because of the high growth rates of the chemical industry in our country, the production of materials and items made from synthetic polymers is continually increasing. Their widescale use in the national economy has posed hygienic science and sanitation practice with a number of new problems, and the need to solve them has brought about the origin and development of new studies in communal hygiene--the hygiene of using polymeric materials.

It must be emphasized that the scientific, methodological, organizational and practical bases of the hygiene of using polymers in construction and everyday life were first conceived in our country at the end of the 1950's and the beginning of the 1960's due to the research begun at the Moscow Scientific Research Institute of Hygiene imeni F.F. Erisman, at the Department of Communal Hygiene of the Rostov Medical Institute and at the Kiev Scientific Research Institute of General and Communal Hygiene imeni A.N. Marzeyev, and then--at the All-Union Scientific Research Institute of the Hygiene and Toxicology of Pesticides, Polymers and Plastics (VNIIGINTOKS, Kiev], established at the end of 1964, at the Institute of General and Communal Hygiene imeni A.N. Sysin of the USSR Academy of Medical Sciences and at the Department of Communal Hygiene of Moscow Medical Institute No 1. In the second half of the 1960's studies were begun at other scientific and practical institutions in the country, the number of which is continuing to grow, and publications have also begun to appear by foreign authors.

It was noted in the report of the Committee of Experts of the World Health Organization, No 544, that "the new synthetic materials may cause new types of dangers of a toxicological nature," and a description is given of the practice formed in the USSR of a careful hygienic evaluation of polymeric

materials, before they are permitted for use in widescale construction. This may be regarded as international recognition of the priority of Soviet hygienic science in establishing and developing this new problem.

Among the particular factors involved in the use of polymeric materials in construction and caused by the special features of the composition and technology for obtaining them, the following should be mentioned: chemical (migration to the air of the facilities of chemical substances, the formation of highly toxic products when the materials are burned), physical (charges of static electricity on the surface of the materials, static electrical fields, the possible effect on the indices of air ionization, low heatproof properties of some of the structures of the floor, unfavorable changes in the microclimate of the facilities) and the biological, caused by bactericidal or possible stimulating effect of polymeric materials on the growth of microorganisms.

By now the theory is generally accepted that for hygienic importance, the gravity of the possible negative consequences, just as for an improvement in the methodological approaches that have formed for the study, the volume and reliability of the accumulated factual data, first place among the factors listed should be given to the danger of the migration into the air of complex sets of low-molecular volatile chemical substances.

The substantiation, radical nature and hygienic efficiency of the health-improving measures depend on the completeness and scientific reliability of the ideas on the nature and degree of biological action of the factors arising in man's environment in connection with the use of polymeric materials in construction and everyday life, which in turn is predetermined by the accuracy of the hygienic requirements for it, the methodological level of the research and the correctness of the results obtained and the criteria chosen for the evaluation.

The use of polymeric materials in construction and everyday life should not cause any sort of direct or indirect adverse consequences, manifested in the near or distant future, extending to present or future generations of people in consideration of the combined, complex and compound action of chemical, physical and other factors of the environment.

The problem of the criteria for the harmlessness of polymeric building materials (PSM) as a new factor of the chemical nature of low intensity in man's habitat has taken on a controversial nature. Some specialists thought that the criterion for harmlessness could be only the lack of migration from the PSM into the air of the facilities of chemicals, and others admitted the possibility of norm-setting for their content in the air at the level of inactive concentrations. The latter point of view is held by more adherents (A.N. Bokov; K.I. Stankevich, and others). In the light of this, there is great practical significance in the substantiation, adopted in VNIIGINTOKS, of the permissible levels for 60 chemicals emitted from polymeric materials. At the same time, attention was directed to the difficulties in setting norms

for the chemical factor and supervising the quality of polymeric materials under conditions of pollution of the air in the facilities with extremely complex combinations of chemicals, which necessitates the improvement of the methodological procedures for quality control of the materials and items at the stage of their production.

The studies connected with the development of methodological approaches to the hygienic evaluation of polymers were of fundamental significance.

Beginning with the earliest stages of development of the problem, attempts began to be made to ascertain the possible unfavorable consequences of using polymeric materials in construction and everyday use in full-scale inspections that made it possible to obtain quite valuable data on the pollution of the air of facilities with chemicals and other undesirable changes in the habitat, as well as on the unfavorable effect of these factors on the population's state of health.

However, despite the continuous improvement in the organizational and methodological procedures for setting up the research under natural conditions and their considerable socio-hygienic usefullness, it has become increasingly obvious that they have a number of essential shortcomings that make it impossible to solve many urgent problems. Specifically, only the polymers produced by industry and finding use in construction can undergo full-scale investigation; the data on their effect on the population's state of health may be obtained only after quite a long period of operation of the buildings and structures. At the same time, the lack of data on the disorders in the state of health of those observed still does not indicate an absence in the habitat of unfavorably acting factors, and, consequently, does not make it possible to evaluate the materials positively.

A method has been developed at the Department of Communal Hygiene of the Rostov Medical Institute to study the biological activity of polymeric construction materials under modeled conditions (A.N. Bykov).* The essence of the method is that, in special generator-chambers, where the materials being studied are present, the possibility is created in wide limits of model study and an unrestrictedly long time of sustaining the actual conditions of operation of various buildings and structures, which causes air to be obtained that satisfactorily corresponds to the full-scale conditions of the habitat with respect to the quantitative and qualitative characteristics of the chemical pollution. The air emerging from the generator chambers is studied according to a methodological scheme that at present includes six stages: sanitation-chemical study, odorimetric observation, determination of the reflector action, a study of the chronic resorptive general toxic effect, a study of the genetic danger and determination of the allergenic activity.

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* The method is recommended for use by the "Metodicheskimi ukazaniyami po kontrolyu za primeneniyem polimernykh stroitel'nykh materialov, prednaznachennykh dlya stroitel'stva zhilykh i obshchestvennykh zdaniy" [Methodological Directives for Supervision of the Use of Polymeric Building Materials Designed for the Construction of Housing and Public Buildings], Moscow, 1970, approved by the USSR Ministry of Health.

The second and third stages consist of observing people (with short-term, 5-15-minute inhalation by the examinee of air from the generator-chambers), the fourth and fifth--in a chronic experiment on white rats and mice (with 24-hour inoculation for 3-6 months) and the sixth--on guinea pigs (with inoculation lasting up to 30 days). VNIIGINTOKS worked out an improved model of the generator chamber for sanitation-chemical studies of the PSM and the study of the kinetics of singling out the chemicals from them.*

Of the many advantages of the method of studying under modeled conditions, the following are sufficient to give: the potential for evaluating not only the industrial, but also the experimental samples of PSM, the structures and any combinations of them, and also to serve the purposes of developing modified and, which is particularly valuable, new nontoxic PSM; the possibility, with the aid of experimental models, of studying the conformances to principle of the interrelation of the chemical factor and the human organism and warm-blooded animals at a level which permits the ascertaining of conditions of the optimum or indifference, which gives sufficient grounds for a favorable hygienic evaluation of the polymeric materials.

By now our country has accumulated quite extensive data on the studies of about 800 industrial and experimental samples of PSM, made using various methodological procedures.** Practically all the materials (with extremely rare exceptions) are sources of migration into the air of certain specific quantities of chemical substances. The results of a study of the kinetics of migration into the air from polymeric materials of chemical substances due to various factors are of definite theoretical and practical significance. The knowledge of these conformances to principle makes it possible to predict the behavior of polymeric materials under operation conditions, which raises the validity and reliability of health-improvement measures. In addition to the odor, reflector and resorptive chronic general toxic action (which has been dealt with in many publications), as studies of the last few years have shown, many PSM possess allergenic properties, and also, according to the results of experimental research, give a mutagenous and gonadotoxic effect.

The results obtained in the development of new or modified nontoxic polymeric materials with the creative collaboration of hygienists and chemical-technologists are of great hygienic importance. In the process of such studies, related to the hygienic approval of various technological procedures for reducing toxicity, a considerable number of materials were found that met hygienic requirements. Similar developments were the subject of inventions including the nontoxicity of PSM and items as a basic distinguishing index. Of positive importance are the "Lists of Polymeric Materials and Items Permitted for Use in Construction," regularly published by the USSR Ministry of Health.

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* Stankevich, K.I., "Hygiene of Using Polymeric Building Materials and the Principles of Their Evaluation," Doctoral Dissertation, Kiev, 1972.

** Bokov, A.N. and coauthors, "Gigiyena primeneniya polimernykh materialov" [Hygiene of Using Polymeric Materials], Kiev, 1976.

In the study of the physical factors related to the use of polymeric materials in construction, the greatest amount of work has been devoted to the study of the heat-shielding properties of floors with polymeric covering and also the charges of static electricity on their surfaces. Specifically, a connection was established between the coefficient of thermal activity of the floors, on the one hand, and the heat-exchange reactions and rate of catching cold of the population, on the other hand. The coefficient of thermal activity of the floor coverings was recommended at a level not over 10 and 12 $kcal/m^2 \cdot hr \cdot 1/2$ degrees for the main facilities of housing, children's, and dispensary-clinic buildings and other public buildings respectively. The effect of static electricitv on conditions for residence was studied. With the aid of a specially developed unit, K.I. Stankevich (1972) experimentally substantiated norms for the intensity of static electricity on a surface of PSM (not over 150 V/cm), which is in accordance with that recommended earlier by N.S. Smirnitskiy (1966) on the basis of the results of full-scale observations.

Since under modern conditions a person may be exposed to the unfavorable effect of many factors simultaneously, the development of an investigation on the study of the combined effect of chemical substances and certain physical factors during the last few years is of theoretical and practical interest. It was established at the Moscow Scientific Research Institute imeni F.F. Erisman that a static electrical field changes the course of the toxic effect on animals by dibutylmaleinate. A study of the characteristics of using polymeric materials under hot climatic conditions made it possible to pose the question of the need for a differentiated approach to setting norms for the permissible content in the air of facilities of chemical substances in different climatic regions in the country.

Further studies in the hygiene of the use of polymeric materials in construction and everyday life should be directed, on the one hand, toward more rapid introduction of all the necessary measures in public health practice and the national economy, and on the other--to a further improvement in the methodological and organizational level of the research, in accordance with the nature of the difficulties arising and the still unsolved problems.

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THE STATE OF THE PROBLEM OF HYGIENIC NORM-SETTING FOR UNFAVORABLE FACTORS OF THE PRODUCTION ENVIRONMENT IN THE USSR

Moscow GIGIYENA I SANITARIYA in Russian No 11, 1977 pp 42-46

[Article by Professor N.F. Izmerov and A.I. Korbakova, Institute of Work Hygiene and Occupational Diseases of the USSR Academy of Medical Sciences, Moscow]

[Text] One of the most important achievements in Soviet hygiene is the development of the theoretical bases for making the environment healthier, and the main place here is occupied by problems of hygienic norm-setting.

The history of the formation and development of work hygiene and occupational pathology in the USSR is integrally bound with the study of methodological problems of hygienic norm-setting and the principles of establishing the safe levels of the effect of unfavorable factors in the production environment. A summarization of the accumulated data of a theoretical and practical nature, particularly clinical-statistic data, made it possible to formulate the basic methodological prerequisites for regulating the effect of these factors. Among these are the threshold factor of the effect (including radiation) of all the factors, given the corresponding criteria of harmfulness and the possibility of establishing safe levels of the effect, orientation, in establishing the hygienic norms, toward medical indicators and not today's technical attainability or economic expediency, and the legislative nature of the norms and GOST [All-Union State Standard] approval of the system of safety for work conditions, in consideration of the hygienic requirements.

On the basis of the methodological concepts listed, substantiated for the first time for the effect of chemicals, principles and methods were developed to substantiate the hygienic norms for various unfavorable factors in the production environment of a chemical and physical nature.

When establishing the criteria and substantiations of the hygienic norms for noise and vibrations, an adequate physical criterion for the characteristics of processes involving vibration is the power of the vibrating process in effect in the zone of contact with the tissues of the organism. Acoustic pressures (noise, infra- and ultrasound) or vibration rates (vibration and contact ultrasound), measured in the zone of contact, may serve as the

parameters for which norms are set. The possibility of evaluating the biological effect of noise and vibrations on the basis of the power concept affords broad possibilities for establishing the permissible daily (or weekly) dose of power of the affecting factors, ensuring, under the work conditions (in consideration of the load and tension of the work) prevention of functional disorders or illnesses caused by these factors.

The USSR has now established hygienic norms for practically the entire radiofrequency range. They have played an important role in making labor conditions healthier for those working with sources of radio waves in the most varied sectors of the national economy. Data have accumulated, however, that dictate the need to intensify the study of the affecting mechanism of electromagnetic waves (EMV) of radio frequencies and make the existing maximum permissible levels more precise. Studies made in the laboratory of electromagnetic waves of our institute established that the dosage or power approach, allowing for the nonlinear relationship of the biological action of EVM to their intensity, is applicable for the effect of the microwave range.

Norms are set for ionizing radiation according to the value of the maximum permissible dose (PDD) absorbed by human organs and tissues. The PDD is the yearly level of personal irradiation, not causing, with a uniform accumulation of the dose in the course of 50 years, unfavorable changes in the state of health of the person actually irradiated and his descendents (NRB-69) that are detected by modern methods. The concept of the threshold factor, with the introduction of a certain coefficient of reserve in transferring the data obtained in experimental animals to man, which is the basis of the existing system of norm-setting for the radiation factor, proved to be quite reliable. This was confirmed by the results of numerous clinical-statistical studies of broad groups of people who come into contact with radioactive sources and substances.

In hygienic norm-setting of the microclimate, as the initial position in principle the theory is used that the norms should ensure the optimal permissible combinations of meteorological factors. At the same time, in contrast to the principles of hygienic norm-setting of the microclimate according to the indices of the total determination of meteorological conditions (indices of effective temperatures, cooling capacity of the catathermometer, etc.), the USSR and other socialist countries have adopted the principles of separate norm-setting for components of the microclimate (temperature, relative humidity and movement of the air), in consideration of the work performed and man's adaptation and acclimatization to various production factors. The approaches in principle of Soviet hygienists to norm-setting for the production microclimate with respect to individual meteorological components were approved at a congress of the Expert Examining Committee of the World Health Organization in 1967.

The USSR as a rule establishes most of the norms for chemical and physical factors of the production environment in two stages: substantiation of the hygienic norms in experiments on animals or studies of volunteers, which

coincides with the period of laboratory or semi-plant studies of new chemicals, industrial processes, equipment, and correction of these norms through a study of the labor conditions and the state of health of the workers (clinical-statistical methods).

Great importance is attributed to clinical-statistical methods in the substantiation, and particularly the revision of the hygienic norms established in the experiment. Because of this, in the last few years considerable attention has been paid to working out methodological approaches to clinical-hygienic norm-setting for unfavorable factors in the production environment, primarily the PDK [maximum permissible concentration] of chemicals in the air of the work area. This made it possible to work out principles and methods of clinical substantiation of the hygienic norms, giving a complete evaluation of PDK not only from the standpoint of the direct effects, but also in consideration of the long-range consequences of the effect. The clinical-hygienic substantiation of PDK of chemicals, just as, obviously, of other factors, particularly in consideration of the long-range consequences of the effect, should be based on the data from long-term dynamic observations of the state of health of those working with concentrations of substances at the level of the PDK, allowing for the socio-economic factors. The need for many years of observation of the hygienic situation and state of health of the workers makes this way quite labor-intensive and long. Obviously, it may be used selectively and only as applied to substances, contact with which is very high.

L.Ye. Milkov suggested a different principle--determining concentrations harmful for the health of the workers on the basis of studying the relationship of dose--effect--time, using mathematical and mathematical-statistical methods of research. This prediction of harmless levels of effect is possible with the correct selection of the clinical-physiological indices that are informative for the given substance, a sufficient number of people exposed for varying lengths of time and working under the conditions of the effect of different concentrations of the chemical. For example, the value, determined by this method, of the concentration of dibutylphthalate dangerous for health proved to be 1.0 mg/m^3 (PDK, substantiated in an experiment on animals, was 0.5 mg/m^3). Therefore, on the basis of the mathematical model study of the pathological process, it proved possible to determine the approximate safe levels of the effect (OBUV) of the chemicals for humans.

The changes detected in mass investigations of workers in the functional state of the organs and systems may be correctly understood and evaluated only on the basis of the concept of the fluctuations of these indices in essentially healthy persons. The summarization, made in the institute's clinic, of the literary and personal data characterizing the work of the principal organs and systems in essentially healthy persons made it possible to determine the indices of the functional state of the cardiovascular, respiratory, circulatory and endocrine systems and of a number of analyzers, as well as certain biochemical parameters and data of the immunobiological reactivity for the norm.

On the basis of the fundamental theoretical and methodological principles, and taking into consideration the characteristics of the effect of chemical and various physical factors of the environment and the results of studying the correlation of biological actions and various levels of effect, it was proven possible to predict the harmful effect of production factors, and methods were proposed for substantiating approximate OBUV. Studying the toxicity of the group of chemicals that had specific irritating properties in critical and chronic experiments made it possible to construct the mathematical models for predicting the OBUV of these substances in the air of the work area. Approximation of the experimental data and an analysis of many regression models, made on an electronic computer, made it possible to work out the formulas for ascertaining the OBUV of specific irritant poisons, based on the parameters of toxicometry established in the short-term experiment. The correlation relationship revealed between the marked nature of the irritating effect of the poisons on the skin and the respiratory function made it possible to propose a method for screening the substances for study according to the proposed accelerated method. A study has now begun of the possibility of predicting the threshold of the chronic action to establish the OBUV of substances exerting a specific hepatothropic effect.

The plan for improving the methods and principles of hygienic norm-setting studies, in dynamics, the organism's adaptation to the effect of the factors of a production environment with low intensity, and develops methods and approaches to delineate the stage of true physiological adaptation and compensation for the pathological process. Specifically, there was substantiation of the use of various loads--nonspecific physiological, specific for the affected organ or system, extremal for the entire organism--which makes it possible to establish with greater motivation the PDK for chemicals and the levels of the effect of physical environmental factors.

In the actual production environment, it is not isolated chemical or physical factors that affect the organism, but their varied mixtures and combinations. Working out the principles and methods for setting norms for the combined effect of the factors in the production environment is one of the urgent problems of hygienic science. The experimental and clinical-statistical data accumulated in this respect made it possible to reveal that the combined action of large quantities of chemicals lethal and tolerable concentrations and doses) determines the differing effects (taking antilogarithms, summation, antagonism, independent effect). A simple summation of actions is noted in the combination of the substances on the level of the threshold of chronic effect with a unidirectional nature of the effect. Substances with a multidirectional nature in their action (narcotics, irritants, etc.) cause an independent effect. Taking antilogarithms with the effect of low concentrations of substances is observed exceptionally rarely. The conformances to principle noted were formulated in the notes to the list of PDK in SN-245-71 for practical use.

The results of the research done in the USSR to study the combined effect of chemicals and physical factors make it possible to think that the

conformances to principle established for the combined action of chemicals are also characteristic for these combinations, i.e., in the combined action of chemicals and physical factors on low levels, an additive effect is as a rule observed. Because of the pollution of the environment with chemicals and the possibility of their entering the human organism from various media (air, food, water), the question has arisen of studying the principles and methods of evaluating their comprehensive effect on the organism. The accumulation of experimental and clinical materials and discussion, with the aid of the methodological approaches listed, will make it possible to work out the permissible levels of the effect.

Harmless levels of effect of unfavorable factors in the production environment are not optimal. All accessible methods and means must be used in the attempt to reduce them and ensure for production optimal or comfort conditions. Consequently, working out approaches in principle to norm-setting for factors in the production environment to create comfort conditions is also urgent (N.F. Izmerov, I.V. Sanotskiy, 1976).

Guided by the methodological principles and theoretical aims in the sphere of hygienic norm-setting for production environment factors, based on dialectic-materialist teachings and the advantages of the socialist system, in the future a study should be made of the principles and methods of investigating the factors of the work process that have a favorable influence on work efficiency and health, and the appropriate norms should be substantiated on the basis of this.

In looking into the future, the problem should be posed of the need to work out methods and principles of vocational screening and vocational orientation in consideration, not only of work efficiency, labor productivity and the physiological characteristics of the organism, but also of the psychological compatability of the work collectives.

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RESULTS OF RESEARCH ON PREVENTIVE HYGIENIC MEASURES AGAINST CHEMICAL CARCINOGENESIS

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[Article by L.M. Shabad, Division for the Study of Carcinogens of the Oncological Scientific Center of the USSR Academy of Medical Sciences, Moscow]

[Text] About 40 years ago (1938), it was shown in my report at the All-Union Conference of Hygienists (Moscow, Institute imeni V.A. Obukh) that the results of certain experimental-oncological research could be placed at the service of hygiene. An important stage in the development of this direction was the program report of A.N. Sysin, L.A. Zil'ber, V.A. Ryazanov and L.M. Shabad, "Hygiene Problems in Studying the Problem of Cancer," presented at the 13th All-Union Congress of Hygienists (Leningrad, June 1956). In this joint presentation by hygienists and experimental oncologists it was said that "regardless of the views on the etiology and pathogenesis of tumors, the adherents of various theories recognize the presence in the environment of a number of factors that play an indisputable role in the occurrence of tumors." And, further: "... the study of these factors creates the basis for organizing cancer prevention by eliminating their effect on the organism ...." Among the principal problems, special mention was made of "studying various blastomogenic chemicals in pollution of the air, soil, food additives, etc. and working out measures to render them harmless." Therefore, in our country the problem of chemical carinogenesis has long been regarded as a hygienic one.

The idea of carcinogens arose on the basis of the observations of occupational neoplasms, particularly often encountered among persons in certain vocations that have long been in contact with certain health hazards. Primarily included among these tumors are cancer of the skin, lungs and the urinary bladder. Without discussing the generally known data on various occupational neoplasms, we note that in the last few years new types of them have been recorded, for instance angiosarcoma of the liver resulting from prolonged contact with vinyl chloride.

The most general conclusions to be drawn from the observations of occupational tumors are that certain exogenous chemical (and sometimes also physical--radiation) agents may actually cause malignant tumors in man, that this as a rule occurs many years after the beginning of prolonged contact with them and that these are usually preceded by certain (precancerous) changes. These facts serve as the basis for the prevention of occupational tumors through ascertaining and eliminating (or reducing the amount) the agents affecting man and (or) through prompt elimination of the precancerous changes.

Occupational tumors constitute only a small part of all human neoplasms, but their study has led to the idea that production carcinogenous hazard may become considerably more widespread and communal, affecting the broadest masses of the population. An example is the pollution of the environment with the carcinogenous discharges of heating systems, industrial enterprises and internal combustion engines (motor vehicles, ship engines, airplanes).

During the last 25 years in our laboratory a great deal of research has been done devoted to the ascertaining and quantitative determination of various chemical carcinogens in man's environment. In this case principal attention was focused on polycyclical aromatic hydrocarbons (PAU) and particularly on the most characteristic representative of them--benzpyrene (BP). The basic results of the work were published by L.M. Shabad in 1973.

We observed the unique circulation of PAU. They are emitted into the atmosphere, settle on the earth, penetrate the reservoirs, plants and then directly or indirectly--into the fodder of animals and, with food, into the human organism. In this circulation, in some units of the chain and under certain circumstances, an accumulation may take place, and under others, the destruction of the chemical carcinogens may occur. As the result of their dissemination and of these processes, a unique background is created for these substances in the environment. In actuality, among many hundreds of soil samples studied in our laboratory, there was not one in which there did not prove to be at least a small--up to 5 μkg/kg--quantity of BP, which we do consider background.

We regard BP as the indicator of the carcinogenous nature of PAU, since it is the strongest of those PAU disseminated in the environment, and it, as a rule, is accompanied by other, less carcinogenic or quite inactive substances. Our evaluation of the indicator significance of BP was acknowledged on an international scale (for example, the symposium on "Air Pollution and Cancer," Stockholm, March 1977). Because of this we are planning to monitor BP in the environment.

The BP background in the environment is created by the spread of this substance throughout the earth and the above-mentioned principal sources of its discharge into the environment, probably mainly by aviation. The destruction of BP, for example, by multipurpose oxidases of soil

microorganisms, takes place most likely in accordance with a type of chain reaction, which dies down as the level of this substance in the environment is reduced, but does not end.

In addition, it should be borne in mind that in addition to exogenous BP, which is the product of man's activity, natural BP may also be formed as the result of its synthesis in nature.

For example, certain authors have pointed out the possibility of BP synthesis by bacteria, algae, and various land plants. Our experiments (K. Bettig and coauthors, 1976) showed the possibility of forming BP in the germinating seeds of various agricultural plants when a substratum containing carbon is added to the medium.

In addition to biogenous natural BP, this substance is also found in nature of abiogenous origin. This possibility was established for the first time due to the discovery of BP in volcanic ash and other products of volcanic eruption. In the course of the corresponding expeditions, there were gathered, and then studied, numerous samples of lava, soil, vegetation, and bottom sedimentation in the area of volcanoes and geysers on Kamchatka, Sakhalin and Kuril islands. BP was detected in all these samples. It is interesting that it was also found in deep (1-2 meters) layers of soil in the permafrost area and, consequently, one may be assured that it had been there for many tens of thousands of years. One may imagine that BP first appeared as the result of pyrogenetic processes related to volcanic activity, and then its synthesis by plants began and only afterwards did its quantity begin to increase considerably as the result of man's work. According to the calculations of American researchers, the amount of BP entering the environment is approximately 5000 tons per year. The overwhelming majority of it is represented by the so-called anthropogenic BP.

The possibility of the natural origin of chemical carcinogens has now been firmly established. In addition to the natural PAU, which were just discussed, the carcinogenic properties of aflatoxins, the products of the mold of Aspergillus flavus, are widely known. The carcinogenic effect of certain pyrolysidines, the alkaloids of the African plant, Senecio (ragweed) has long been described. A strong carcinogenic substance is cicazine, contained in the leaves and fruit of the palm, Cicas Circinalis, which grows on the island of Guam. All these natural carcinogens may enter food and serve as the cause of certain malignant neoplasms, particularly cancer of the liver, among the population of certain parts of Africa and Southeast Asia.

Because of such a wide spread of carcinogens in man's environment, the problem of hygienic prevention of chemical carcinogenesis is being posed differently. While, with respect to individual carcinogens, such measures as reducing the amount of their emission through improving the technology of individual production facilities or structures and even complete elimination through substituting other substances are possible and necessary, for the

universally disseminated or natural carcinogens, certain hygienically permissible norms must be established in different spheres of the environment. By limiting the PDK of a certain specific carcinogen, for example, in the atmospheric air, we create, so to speak, a shield that directly protects the population against the harmful effect of chemical carcinogens, regardless of the many sources of their origin and emission.

The problem of hygienic limitation of carcinogenic substances has its own history. For many years it was thought that it was impossible to determine the PDK or PDD for carcinogens, because of their lack of the action of a threshold, and mainly due to their damaging the cell genome. Druckrey proposed even the concept of "genotoxicology," and suggested that not even one dose of a carcinogen could help but give an effect. In the last 10-12 years, however, opinions changed. Our article (L.M. Shabad, 1966) pointed out that, despite a number of difficulties, hygienic limitation of carcinogens was possible and necessary. The principal basis is the relationship of the carcinogenic effect to the dose, firmly established in experiments (N.Ya. Yanysheva and coauthors). As for the lack of a threshold in the action of chemical carcinogens, in this respect they do not differ from radiation, for which, despite the lack of a threshold, certain limits have been established in accordance with international agreements.

We cannot discuss further the difficulties and possibilities of hygienic limitation of carcinogenic substances, since they were dealt with in detail on the pages of the journal, GIGIYENA I SANITARIYA, during the past 10 years.

The basis for establishing PDK should be extensive experimental research, as the result of which noncarcinogenic doses of the substance being studied are determined. Extrapolation of the experimental data for man is a complex and critical task. The appropriate mathematical models should be used in this case. It is totally necessary to take into consideration all the available information on the effect of the substance studied on individual groups of the population, especially the results of the vocational-pathological and epidemiological studies. Finally, one should bear in mind the content of the combination that interests us in various spheres of the environment, especially its background level, if it is spread universally.

The approaches enumerated made it possible to propose PDK for BP, which were also confirmed by the USSR Ministry of Health in 1972 and 1973, in the amount of 0.1 μkg/100^3 for the atmosphere of populated places and 15 μkg/100^3 for the air of the work area of certain enterprises. In 1976, the USSR Ministry of Health, on the basis of data obtained by A.P. Il'nitskiy and N.Ya. Yanysheva, approved the PDK of BP in the water of reservoirs as 0.005 μkg/1. Data are now being accumulated in order to work out the PDK of a given carcinogen in the soil. In this case allowance should be made of the conformances to principle of its transfer to plants, particularly those which may be used as food (for example, potatoes and other vegetables).

Because of the problem of hygienic limitation of the chemical carcinogens in the environment, an important question, new in principle, arises: can there in general be a change in the frequency of occurrence of malignant tumors? The results of modern epidemiological research give a positive answer to this question.

The dissimilar frequency of tumors in different countries and among different groups of the population in itself shows that, along with high-risk groups there are also those for whom the threat of illness is less. The study of the cancer morbidity among persons moving from some countries to others (migrants) is particularly important.

In the last 10-15 years it was revealed that English people who moved to Australia, South Africa, the United States and Canada are stricken with lung cancer more often than the natives of the country to which they have moved, but less often than their countrymen who remained in the native land. The latter is particularly true of people who left England in early childhood.

Carcinoma of the stomach is most characteristic of Japan. However, among Japanese who are living in the United States, for example in California, it is encountered considerably less often than in Japan, but still, more often than among the surrounding population. In the second and third generations the morbidity of carcinoma of the stomach among the descendents of Japanese who have moved to the United States is lower and goes to the level common for inhabitants of this country.

The facts given are explained, of course, by changes in the conditions of the habitat, including the food, the air inhaled and the water. In order to ascertain all the carcinogenic factors and the conditions of their effect in given cases, numerous studies are still necessary. It may already, however, be stated with certainty that the morbidity from the major types of cancer undoubtedly depends on the living conditions, environment, nature of the nutrition, etc., and that, by changing them, it may be reduced. This means that the hygienic prevention of cancer is in principle possible and actual.

To carry it out in the presence of established PDK, extensive state and technical measures are necessary. For example, to protect the air of cities from pollution with carcinogenic substances, it is very important to have centralization of the heating systems and the most complete burning of fuel, substitution of liquid fuel and liquid gas for solid fuel. A substantial role may be played by reducing the amount of carcinogens in the exhaust gases from motor vehicle transport and even efficient urban development, specifying sufficiently broad, well aired streets, and underground passages, due to which motor vehicles do not pile up at intersections, etc. Reducing the amount of harmful emissions from industrial enterprises may be achieved by introducing waste-free production processes (BOT). Similar measures may also pertain to other environmental spheres. The established PDK may be used to monitor their efficiency.

In summing up the state of the problem, it may be said that there are now more and more supporters of the possibility of and need for hygienic limiting of carcinogenic substances. The experience accumulated in this respect in the USSR serves as an example in discussing this problem at international conferences. While formerly the stumbling block was the idea of the damage by carcinogenic cell genomes, now, in the light of the data on the possibility of DNA reparation, this objection may be removed. Of course, there must be further intensive studies on the mechanisms of carcinogenesis and a more precise determination of the metabolism of various carcinogenic substances. After all, it is now known that most carcinogens found in the environment, including PAU, are only "procarcinogens," which are activated in the organism and only after this become true carcinogens, attacking certain targets in the cells. In environmental pollutants, carcinogenic substances are found, of course, not in pure form, but in complex mixtures. In working out PDK, one should take into consideration the special features of the metabolism of various chemical carcinogens and their combinations and interrelations both in the environment and in the human organism.

We regard each PDK as the maximum permissible concentration determined on the basis of scientific data and methods now available; with the accumulation of new information and approaches, it may be revised and changed. Our ultimate goal--based on the law of the relationship of the carcinogenic effect to the dose--is to permit contacts only with doses of carcinogens small enough that they could cause malignant neoplasms only many years after the initiation of the effect. In other words, our goal is to remove the disease of cancer beyond the limits of the most prolonged human life.

All of the above shows that Soviet researchers, working at the junction of oncology and hygiene, are arriving at the 60th anniversary of the Great October Revolution with definite theoretical and practical achievements.

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